THE

JOURNAL OF GAS LIGHTING,

WATER SUPPLY, & SANITARY IMPROVEMENT.

[REGISTERED AS A NEWSPAPER.]

VOL. XXVI. No. 644.] LONDON, SEPTEMBER 14, 1875. [27TH YEAR.] Price 6d.

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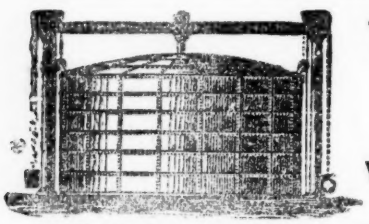

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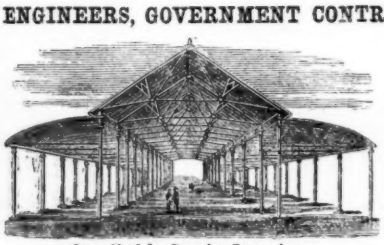

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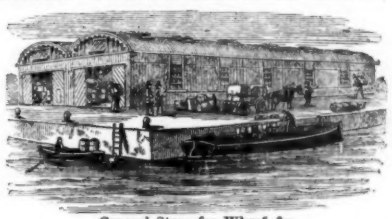

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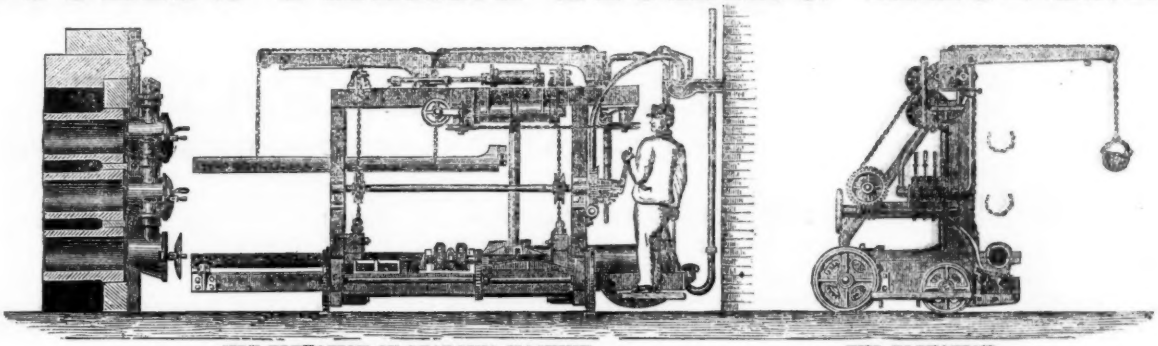

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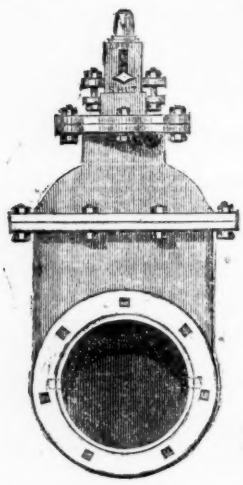
C. & W. WALKERS' DOUBLE-FACED GAS-VALVES.



These solidly constructed double-faced Gas-Valves are superseding the old system of the light, single-faced disc, which is too uncertain and unreliable in large bores.

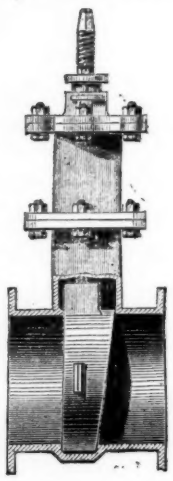
They are guaranteed absolutely gas-tight. They are very massive and rigid, and by improved modes of manufacture they are produced at very little excess in cost over the old light, weak system, which is liable to spring and bend, and become leaky.

The Valve is a rigid wedge of solid cast iron, having two perfectly scraped surfaced facings fitting between the two on the body, which are also surfaced.

A spring in two short halves, and, therefore, not liable to break, is used only for scraping the front facing clean.

The front facing is vertical; the back facing forms the wedge.

At a slight additional expense both flanges are faced to bolt to main-pipes.



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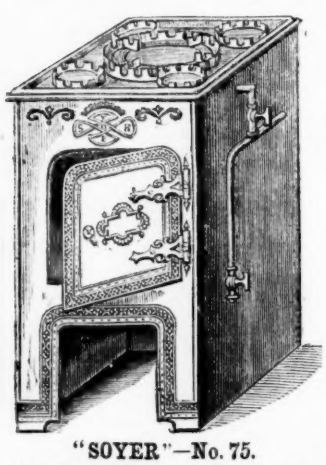

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ON THE

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LAMP METERS, IN CAST-IRON BOXES,

FOR

Fixing in the Footway, flush with the Pavement, with roughed Lids.

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They have since been used in several important towns, with equally good results.

No other kind of Lamp Meter has ever achieved so complete a success.

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WITH

STEATITE INCORRODIBLE BURNERS.

Guaranteed to give the greatest amount of light for the quantity of gas consumed.

The amount of light for a like quantity of gas is at least 30 per cent. over that given by those burners generally employed in public lighting.

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LEVER COCKS FOR POLE LIGHTING,

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These Cocks are carefully made so as to avoid Stoppage by Naphthaline, Leakage, and Friction.

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Are acknowledged to be the best of their kind, and are almost universally adopted.

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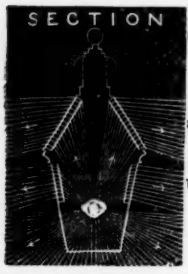

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Is now in use in Moorgate Street, Cheapside, and Trafalgar Square, and has been in successful operation upon Waterloo Bridge since Oct. 7, 1871.
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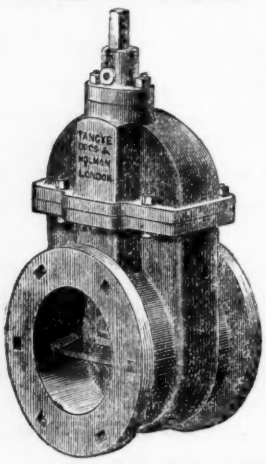

Inch.	s.	d
3	25	0
4	36	0
5	40	0
6	54	0
7	63	0
8	80	0
9	85	0
10	100	0
12	120	0
14	140	0

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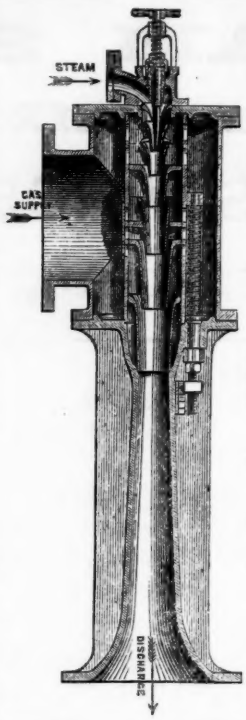

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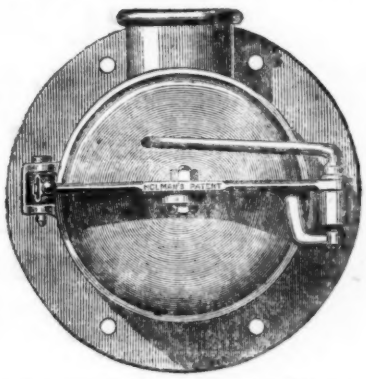

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" Gaslight Co., Silvertown.
" Gaslight Co., Lupus Street.
" London Gaslight Co.
" Independent do.
" Phœnix do.
" South Metropolitan Gaslight Co.
" Commercial do.
" Imperial do.
" West Ham Gas Co.
" Gas-Works, Barnet.

The Gas-Works, Royal Arsenal, Woolwich.
" do. Lower Sydenham.
" do. Brentford.
" Consumers Gas Co., Woolwich.
" Alliance and Dublin Gas-Works.
" Edinburgh do.
" Manchester Corporation do.
" Salford do. do.
" Rochdale do. do.
" Liverpool Gas-Works.
" Birmingham do.
" Birkenhead do.
" Nottingham do.

The Newcastle-on-Tyne Gas-Works.
" Lurgan do.
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" Merthyr Tydfil do.
" Windsor do.
" Leeds do.
" St. Albans do.
" Over Darwen do.
" Rotherham do.
" Aylesbury do.
" Bournemouth do.
" Ystrad do.
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" Rochester do.

The Keighley Gas-Works.
" Aberdare do.
" Ballymena do.
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The Gaslight and Coke Company (Commonly called the Chartered Gas Company), Beckton, North Woolwich, July 2, 1874.

MESSRS. TANGYE BROTHERS AND HOLMAN.

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(Signed) G. C. TREWBY.

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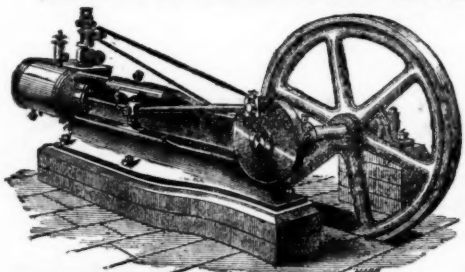

OVER 1500 SOLD SINCE THEIR INTRODUCTION IN DECEMBER, 1869.

In designing this Engine the utmost regard has been paid to simplicity of arrangement, strength of construction, and economy in cost. The working parts are considerably reduced in number, as compared with Horizontal Engines generally, rendering it far more durable and compact, the bed-plate, front cylinder cover, guides, and plummer-block for crank-shaft bearing being all cast in one piece, which in design and proportions is admitted by competent engineers to be perfect, and to afford a strength and rigidity that cannot possibly be attained in the best fitted engines of the ordinary horizontal type. The extraordinary stiffness of this Engine will permit of its being driven at a much greater maximum speed than engines generally, and with far less wear and tear. The cylinder with its valve-chest is bolted to the end of the bed. The cross-head slippers and connecting-rod ends are made adjustable, so that any wear can be readily taken up. The fly-wheel, cylinder-end, connecting-rod, and crank-plate, are all bright. All the parts are made to Whitworth's Gauges, and the material and workmanship are of the highest class throughout.

The Governor is of a very special description, and combines in the small space usually occupied by the ordinary steam stop-valve, a governor, throttle-valve, and stop-valve complete. It is exceedingly sensitive, simple, and compact.

These Engines are adopted in Gas-Works at Greenwich (Phœnix Gas Co.), Haggerston (Independent Gas Co.), Nine Elms (London Gas Co.), Falmouth, Harrow, Jersey, Plymouth, Richmond, Rochdale, Santiago (Chili), &c.

NUMBER NOMINAL HORSE POWER	B 2	C 3	D 4	E 6	G 8	H 10	J 14	K 18	M 25
Price of Engine, with Governor	£32	£38 15 0	£46	£70 0 0	£90	£115 0 0	£145	£185	£200
Feed-Pump, extra	3	3 15 0	4	5 10 0	6	7 10 0	8	10	15
Engine and Vertical Boiler on Base-Plate	75	95 0 0	110	150 0 0	180	225 0 0	280	—	—
Engine and Cornish Boiler, with Fittings	—	—	—	—	—	—	—	—	—
Variable Expansion Gear, extra	—	—	10	12 0 0	13	14 0 0	15	2	25

London 1851. New York, 1853. Paris, 1855. London, 1862.

Dublin, 1865.

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METERS FOR MEASURING WATER.

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TO CORRESPONDENTS.

No notice can be taken of anonymous communications. Whatever is intended for insertion, must be authenticated by the name and address of the writer; not necessarily for publication, but as a guarantee of good faith.

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THE JOURNAL OF GAS LIGHTING,
WATER SUPPLY, & SANITARY IMPROVEMENT.

TUESDAY, SEPTEMBER 14, 1875.

Circular to Gas Companies.

We must call the particular attention of gas managers to the duty imposed on them by the 4th clause of the Conspiracy and Protection of Property Act. A letter on the subject appears in another column, and the section of the Act is appended at length. To comply with the Act, it will only be necessary to have a number of copies of the clause printed in legible type, and to keep one posted in a conspicuous place on the works, as directed.

The Corporation of Walsall have decided on purchasing the mains and other property formerly belonging to the Birmingham and Staffordshire Gas Company, and lying within the borough, on terms already agreed upon with the Corporation of Birmingham. The consideration is the annual payment of £1300 in perpetuity, and the repayment of the sum expended on necessary extensions, made before the completion of the purchase, by the Corporation of Birmingham. If the estimated value of the property is correctly stated by Mr. Brownhill, there can be no doubt that Walsall has made a very good bargain. The ratification of the agreement is, of course, dependent on the passing of a Bill which the Corporation of Walsall will promote in the next session of Parliament. In the meantime, the district will be supplied by the Corporation of Birmingham on the same terms as the borough of Birmingham itself.

The Leicester Gas Company have taken the management of their undertaking back into their own hands, paying the contractors £20,000 for their stock, &c. Having secured the services of the former contractors as joint managers, the last half year's working has proved very profitable to the company, who pay maximum dividends for that period.

The Hartlepool Gas and Water Company also find themselves in a position to declare maximum dividends. It is deemed by the directors advisable to issue new capital, and it will be seen that, in making arrangements for such issue, they have not been unmindful of the interest of the public. Existing proprietors are only to have one share allotted in proportion to eight now held, and the unallotted shares are to be sold by auction. As no shareholder complained of the arrangement, we suppose all are satisfied.

The Hastings and St. Leonards Gas Company, of course, declared full dividends. Gas is dear at Hastings, but the reason is easily explained. There is very little demand for coke in the district, and, consequently, if sold, it has to be disposed of at a ruinous sacrifice.

The Falmouth Gas Company are improving their position, the dividends having risen from 2½ per cent. to 6¼ per cent. since they bought the undertaking. It seems that considerable sums will have to be spent on repairs and replacements for some time to come, and, as these must be taken from revenue, the days of 10 per cent. dividends may be distant. In connexion with this company, we may mention that they successfully appealed against an increased assessment, and have had it reduced from £455 to £252.

The new assessments will, no doubt, give rise to a large number of appeals. The Glasgow Corporation are about to appeal against a valuation of £98,991, put on their gas undertaking—a sum which is about £38,000 in excess of last year's valuation. We may here mention, in correction of a remark made last week, that the Town Council have resolved to continue the discounts to large consumers of gas. The resolution, however, was only carried by the casting vote of the chairman.

We informed our readers some time ago that the Town Council of Swansea had resolved to obtain plans and estimates for works and mains for the supply of gas within their limits. They have recently been furnished with plans, specifications, and estimates, which go to show that the necessary work may be done for £48,000, and we have little doubt that the Town Council will determine at their next meeting to proceed with the works, if they can obtain permission to borrow the necessary funds. But there is the difficulty. They have to apply to the Local Government Board, and we very well know that the Board will never sanction the loan. The Board might consent to the borrowing of money for the purchase of the Swansea Company's undertaking, or they might allow a loan for the construction of works, if none existed, for the supply of the borough. But, to our minds, the 161st section of the Public Health Act distinctly stands in the way of a loan for competing works.

Besides the Local Government Board, the ratepayers of Swansea have to be consulted, and some of these must be shrewd enough to see that the scheme laid before them can only result in additional taxation. The Corporation have recently borrowed of the Bank of England £80,000, at 4¾ per cent., if the interest be not punctually paid, the capital sum to be repaid in ten years. They have water-works and sewerage-works in progress, neither of them remunerative. Surely, with all these obligations on their shoulders, the ratepayers will think twice before they further encumber themselves with a loan, which, if it could be obtained, and the money expended, would not only be unremunerative, but would involve the borough in a great loss.

We say nothing about the possibility of executing the works required for the supply of 200 millions of feet a year for £48,000. We know that the Swansea Gas Company have already expended some £85,000 on works and mains to supply 170 millions a year; and, whatever may be said to the contrary, we believe the expenditure to have been economical. Much of the work was done in times when materials and labour were much cheaper than they are to-day; and further, we know that the late Mr. Jabez Church furnished the Corporation of Swansea with plans for works which were estimated to cost £100,000. We read, with intense astonishment, that Mr. Alderman John Jones Jenkins stated to the council that the plans and estimates now submitted to the Corporation were approved by Mr. Church. We should like to know on whose authority this statement was made. Mr. Church was an able and an educated gas engineer, a man of character and honour, and we cannot for a moment suppose that he could be so far wrong as to make an estimate of £100,000 for works, and find out afterwards that they could be executed for £48,000. Mr. Church died on the 20th of May last, having been too ill to attend to business for some months before his decease, and it would be interesting to know when and where these plans and estimates were submitted to him.

The discussion in the council, of which we can only give a short report, was, in many respects, amusing from the ignorance displayed by some speakers. We shall only notice one or two points, and first we may refer to Mr. Alderman John Jones Jenkins, who says we challenged him to point out a case in which a Corporation managed their works economically. We never did anything of the sort. We may have said that he could not mention a case in which a corporate undertaking was *more economically* managed than one in the hands of a company, but nothing

more, for we happen to know well-managed corporate and badly-managed companies works. The first illustration the worthy alderman gives is, however, unfortunate. He says that the Gas Committee of the Corporation of Manchester, in 1873, gave no less than £58,000 towards reducing the rates. It is quite true that they did pay over some such sum as that named, but it must be pointed out to Mr. Alderman John Jones Jenkins that, if he had read his JOURNAL OF GAS LIGHTING carefully, he would have seen that this sum was paid out of capital, and was not profit made by supplying gas; and the consequence, as we have mentioned before, is that the consumers in Manchester will have no reduction in the price of gas for another year. Walsall is an instance of a Corporation very favourably circumstanced, and with a very small capital account; and they can, of course, supply gas at a cheap rate.

As regards Paddington, "the Corporation" of which is mentioned as having recently acquired gas-works, and made a large reduction in the price of gas, we may say that we only know of the parish of Paddington, the vestry of which have begun to burn gas in the public lamps by meter, and have undoubtedly made a saving. Other speakers fall into similar mistakes, and are quite as disingenuous. One represented Hull as being supplied at 4s. 6d. per 1000, suppressing the fact that the British Gas Company charge in some parts of the borough only 2s. 6d. per 1000 feet. The Plymouth undertaking was represented by one speaker as being in the hands of the Corporation, and by another as belonging to a company; but these may be the vagaries of a reporter. When the matter is again discussed in the council we shall have more to say; for the present we may leave the matter, with a strong recommendation to the ratepayers to see that they are not befooled by a section in the council, who, partly from vanity, and who, it may be, are partly animated by private malice, would drag the town into an abyss of debt it will be difficult to get out of. The case of Limerick no one speaker referred to, and yet that is the most pertinent instance they could have quoted. It is the only case in the United Kingdom in which a Corporation is in competition with a company in the supply of gas, and what has been the result? The Corporation have lost some £40,000, and have a gas undertaking on their hands which nobody will buy. The same result would most certainly happen in Swansea, if works were started by the Corporation. But the thought occurs to us that Mr. Alderman John Jones Jenkins knows very well that the Local Government Board will never sanction a loan for the purpose, or he would not try to persuade his fellow-ratepayers to indulge in the wild speculation of gas at 2s. 8d. per 1000.

The Southampton magistrates are evidently ill-advised. Last month they decided that they had jurisdiction under the Gas-Works Clauses Amendment Act, 1871, in the case of a dispute between a consumer and the gas company, in whose special Act the measure of 1871 is not incorporated. Last week the case came before them in a different form, it being an application by the consumer, under the 20th section, to determine the difference between him and company, as to the quantity of gas he had consumed, the meter having ceased to register. The magistrates on this occasion decided that they had no jurisdiction, thus stultifying a decision from the same bench.

Water and Sanitary Notes.

AT this season of the year, it is usual for the sewage question to turn up for discussion; and accordingly the daily papers have been flooded with correspondence on the unsavoury subject. Recently, additional interest has been given to the discussion by the suggestion of Mr. W. R. Greg, that a portion of the surplus —whenever a Chancellor of the Exchequer is so fortunate as to have one—should be applied in an endeavour to solve the problem of the profitable disposal of sewage, if it be possible, or in discovering the best means of getting rid of it altogether, if no utilization be possible.

Mr. Greg points out that the Rivers Pollution Bill, when it becomes law and is enforced, will impose a task on the country, involving an expenditure of £100,000,000, which, as he says, means rates by the million, or borrowing by the million. The prospect is certainly a dismal one for the, at present, overburdened ratepayer, and then the question arises whether, after all, the work is necessary or desirable. Mr. Greg appears to think that it is not. "The Rivers Pollution Bill," he says, "provides in "effect that, while our sewerage system shall be universalized and "perfected, God Almighty's sewers—our streams and rivers— "'for that end made and provided,' shall no longer be used for "the purpose; that our rubbish, manufacturing refuse, and house-"hold *excrementa* shall no longer be turned into the natural "watercourses, and so carried off to the sea, *but shall be disposed "of and find depositories elsewhere.* In that last phrase lies the "essence of the subject. Elsewhere! Where?" Mr. Greg then takes a glance at the valley of the Thames, and remarks that the effects of the Act referred to will be that "the *excrementa* "of some 10 or 15 millions o people, which has hitherto floated "away to the ocear, must be retained in this country, and *may* "become centres of pestilence." We need not quote further, and will only express a confident opinion that Mr. Greg will never succeed in persuading a Chancellor of the Exchequer to expend any surplus revenue on sewage experiments.

Then comes Mr. Mechi, who, firmly believing in the success of sewage farming—a success, by the way, which he has never demonstrated—and seeing that the public cannot be persuaded to invest money in a scheme for utilizing the sewage of London, coolly suggests that the Metropolitan Board of Works shall guarantee the interest on the capital expended. They may, perhaps, do so—if the Board be in existence—when a surplus is devoted to sewage experiments; but, at the present time, they are just as likely to guarantee interest on the money expended on the tunnel under the Channel.

Among the several communications made to the daily papers, there are a few which tell us of the success attained at some sewage farms. The one at Ashby-de-la-Zouch certainly cannot be considered successful. The Local Board have, since 1870, expended £2254 7s. 8d. on the farm, and they have received in cash £1668 14s. 10d. Credit, however, being taken for stock, valued at £561 15s. 2d., the whole proceeds would appear to be £2230, which leaves the Board with a loss of £23 on the five years working. But this is not quite all. The Board borrowed £600, which was to be repaid by annual instalments of £44 10s. We gather that no instalment has yet been paid, and thus £220 must be added to the loss.

Doncaster, too, has a sewage farm, but the Corporation never succeeded in making it pay. It is now leased to a company, who have been in possession two years, but have not yet paid a dividend. We always thought that sewage, if enough was applied—and it seems to be used unsparingly on the Doncaster farm—was all the manure required. The manager of this farm, however, considers it desirable to make a considerable quantity of fold-yard manure, and intends to dress the land all over with it. This is, no doubt, very advisable; but it is not sewage farming in the ordinarily received sense.

An able correspondent of *The Times* recently published a summary of the accounts of twenty-five sewage farms, which appeared to show that only two pay their agricultural working expenses. As regards one of these—Warwick—however, it seems that a great mistake was made. Mr. Clifford, who, we believe, laid out the farm, and managed it for some years, wrote to say that, instead of a profit, the loss to the ratepayers last year amounted to £423. This farm has now been leased to a company, who are to conduct it on commercial principles.

Whether the Romford farm, which is worked on commercial principles, is a success or not, we shall leave others to decide. We rather think we read recently that splendid crops were grown on it last year, and then were ploughed in, for reasons which we do not remember.

The sewage of Leamington is taken by the Earl of Warwick, who pays the local authority £450 per annum. It costs the Town Council, however, £1046 to take the sewage to the earl's land, so that there is an actual loss of £596. Beyond this, there are the interest on borrowed money, and the annual instalment for repayment to provide; and, taken all together, we may say that the present cost of getting rid of the sewage of Leamington is over £2000 a year. What the Earl of Warwick makes by it is only known to his lordship and his steward.

We must wait for Lord Rosebery's returns for complete details as to the result of farming operations for the utilization of sewage; but we may say that, with the information now before the public, it seems to us highly impolitic for any local authority to engage in sewage farming. There is a great deal to be urged in favour of the plan known as intermittent filtration; but this must be regarded as still on its trial. It is impossible to believe that a small area of land can go on for an unlimited number of years purifying thousands of gallons of sewage, however deep the land may be drained, or however well the filter be constructed. The system has the recommendation of being the cheapest, and may be, for a time, the most effective means of purifying sewage; but we cannot help expressing a doubt whether the benefit will last.

If we turn to the chemical processes, we are still unable to see that the treatment of sewage is likely to result in any relief to the rates. The Native Guano Company have been in existence for several years. The A.B.C. process, as it is called, has been put in operation at Leamington, at Hastings, at Crossness, and has been abandoned. It is now being tried on the most extensive scale at Leeds, and next year may be in operation at Kingston-on-Thames. The company have, it appears, expended on capital

account, up to the end of April last, about £106,000. If they have ever paid a dividend, we do not at the moment remember the fact, nor can we call to mind that the ratepayers have at any place benefited, financially, by the operations of the company. The directors, in their recently published report, speak of it as possible that the effluent water at Leeds may eventually be pumped back into the town for use by manufacturers. When this is done, the shareholders may expect a dividend.

Of the other chemical processes now in use, perhaps the less that is said the better. One thing all the inventors claim to have succeeded in producing, and that is a good effluent water, which means effective clarification of sewage. General Scott, we believe, does not pretend to do so much as this. He only undertakes to produce cement—such as it is—from the heavier suspended matters in sewage, leaving the rest for subsequent treatment.

Our readers know that a roving commission has been appointed by the Local Government Board, who, having visited a few sewage farms and sewage works in this country, have now started for Holland to examine the Liernur system. They will subsequently visit Paris, and inspect the immense sewage farm of the Municipality of that city, on the plains of Gennevilliers, recently described in these columns. The appointment of the commission furnishes towns with a reasonable excuse for refusing to adopt any means of purifying sewage, until the report of the commissioners is published. Such an excuse has been fairly made at Colchester, and will, no doubt, be advanced in many other places. Whenever that report is published, it is not to be anticipated that any specific process or system will be recommended. The commissioners will, no doubt, avoid responsibility by sheltering themselves behind vague generalities, and local authorities will still be left to make a choice. Whatever that choice may be, they must not, according to our present knowledge, expect to realize a profit out of their sewage.

The half-yearly report of the directors of the Birmingham Water Company has been issued, in anticipation of the meeting to be held to-morrow. This will probably be the last half-yearly meeting of the company, for we do not expect much delay in the transfer of the works to the Corporation. The accounts show a prosperous state of affairs. Dividends at the rate of 8 per cent. and 7 per cent. are declared, and there is a substantial balance to carry forward. The paid-up capital of the company is now £637,000, and the amount required for the usual *yearly* dividends is £48,530. From this it is easy to calculate what the Corporation may be expected to pay for the undertaking. Twenty-three years purchase of the annual dividends is rather more than a million of pounds; but the cost to the Corporation cannot be expected to be less than a million and a quarter; and the undertaking will be cheap at the price. The existing works are reported in good condition; and the extensions in progress are being pushed rapidly forward. The Corporation will receive the works in excellent order.

The Water Commissioners of Dundee and the contractors alluded to last week have agreed to a modification of the test stipulated for in the contract. The test will be applied to the pipes as far as Pitnappie, about three miles distant from Dronley, which will include the most important section of the work.

Buenos Ayres Mutual Gas Company.—The *Standard* of Buenos Ayres, under date July 31 last, says: "The report of the Mutual Gas Company is short, satisfactory, and to the point. The establishment, with all its piping, is finished, with the exception of a small portion which has been delayed owing to the loss of a cargo of pipes, but which will be finished by the end of the year. The gas-works are of a capacity for the manufacture of 800,000 cubic feet daily, which might be increased to 900,000 cubic feet; of the 88 miles of piping in the streets, sent out by the contractor, Mr. Bower, 72 miles are laid. All the materials are of the best quality, and the directors are well satisfied with the works. On the 30th of last June the number of consumers of this company's gas was 1900, and they are increasing daily. In January, 1875, the private consumption of gas was 1,154,000 cubic feet per month, and to-day it has reached more than double this figure, say 2,720,000 cubic feet, giving a monthly net yield of 320,000 m/c. There are 2260 lamp-posts, which give 248,600 m/c., and now the municipality is delivering the balance of the lamp-posts up to the contract number of 4200, which will give to the company still greater profits. The municipality owes the company 101,206 patacons, which it is believed they will pay off gradually every month. There are 560 medidores in deposit, and the board has ordered 3000 smaller ones, which would have been here before now had the municipality paid up. The accounts show that the company have been able to pay way regularly, and this speaks well for the company when we take into consideration the difficulties in starting a new enterprise, and the melancholy situation of the country in general, in spite of all which the company have cleared in the last six months, as the previous months count for nothing, 7 per cent. This shows what this company is yet bound to do. The net profit which the company hold is 65,380 pats., which they propose distributing among the shareholders. The capital of the company consists of 20,000 shares of 50 pats. each, of which 2110 shares are at present in the hands or at the order of Mr. G. Bower, the contractor. The company have paid to Mr. Bower, for gas-works, medidores, &c., 865,283 pats. The bills for gas yet to be collected amount to 24,803 pats. The balance due to Mr. Bower for gas supplied is 16,999 pats. Upon the whole we must congratulate the directors and the shareholders upon a position which few who knew anything of the difficulties surrounding this company at starting ever suppose it would so soon attain. Here we have this young company, started under the nose of a millionaire opposition company, earning 7 per cent. dividend in six months, and paying same to its shareholders. We are happy to see that the public manfully supports this young company, for it well merits public support."

Correspondence.

CONSPIRACY AND PROTECTION OF PROPERTY ACT.

(38 & 39 Vict., c. 86.)

Sir,—Under the 4th clause of the above Act, which came into operation on the 1st inst., gas and water companies are compelled to post up in a conspicuous part of their works a printed copy of the 1st section of the said clause, which I enclose, and in default "incur a penalty of £5 per day during which such default continues."

Many of my brother managers, not being aware of it, lay themselves open to conviction, which it is well to avoid.

Gas-Works, Runcorn, Sept. 9, 1875. J. R. Frith.

Breach of Contract by Persons employed in Supply of Gas or Water.

IV. Where a person employed by a municipal authority, or by any company or contractor upon whom is imposed by Act of Parliament the duty, or who have otherwise assumed the duty of supplying any city, borough, town, or place, or any part thereof, with gas or water, wilfully and maliciously breaks a contract of service with that authority or company or contractor, knowing or having reasonable cause to believe that the probable consequences of his so doing, either alone or in combination with others, will be to deprive the inhabitants of that city, borough, town, place, or part, wholly or to a great extent of their supply of gas or water, he shall on conviction thereof by a court of summary jurisdiction or on indictment as hereinafter mentioned, be liable either to pay a penalty not exceeding £20 or to be imprisoned for a term not exceeding three months, with or without hard labour.

Every such municipal authority, company, or contractor as is mentioned in this section shall cause to be posted up, at the gas-works or water-works, as the case may be, belonging to such authority or company or contractor, a printed copy of this section in some conspicuous place where the same may be conveniently read by the persons employed, and as often as such copy becomes defaced, obliterated, or destroyed, shall cause it to be renewed with all reasonable despatch.

If any municipal authority or company or contractor make default in complying with the provisions of this section in relation to such notice as aforesaid, they or he shall incur on summary conviction a penalty not exceeding £5 for every day during which such default continues, and every person who unlawfully injures, defaces, or covers up any notice so posted up as aforesaid in pursuance of this Act, shall be liable on summary conviction to a penalty not exceeding 40s.

GAS FROM BONES.

Sir,—A dozen years ago I sent plant to Australia for a sugar factory for the manufacture of gas from bones, and for the production of animal charcoal. I have also, on several occasions, made gas from bones in Russia. Geo. Bower.

PREPARATION OF LIME FOR PURIFICATION.

Sir,—The attention which the above subject is now receiving, both in this country and in America, proves that there is no matter connected with our profession, however simple, but may be improved by ventilation and comparison of notes.

I think I may safely say, for the engineers of this country, that we are not in the habit of regulating the quantity of water we add to the lime by any of the directions to be found in treatises, such as its retaining its shape when crushed in the hand; for whether it would do so or not would depend on the amount of pressure employed as much as on the quantity of water used, and that the quantity of water to be employed is only limited by the capacity of the lime to hold it without becoming a paste.

While this is our knowledge, I think it probable that we do not all give the manipulation of the lime the attention which it deserves.

I know that men more generally make it too dry than too wet, for I have often had to check them for doing so.

I know also that, if not watched, they will put the lime in looking wet enough, but not sufficiently cooled, so that much of the water may be carried away by the gas in a state of vapour; and, to prevent this, I instruct that, while the lime feels warm to the touch, it is not to be put in. Hence our practice is to slake the lime a day before we use it.

Very frequently I have found that the lime, slaked and finished, ready for the purifiers, was found on the morrow to be quite too dry, and had to be further wetted.

I have also frequently seen, both in my own works and in the works of others, the lime come out of the purifiers quite dry and powdery, not having done half its work. We may, therefore, gain something by giving the matter more personal attention than it has had.

How is the lime to be got to hold the most water?

When the lime is slaked and cooled, apply water from the rose of a watering-can, not in a *douche* from a bucket; the former comes more like the gentle rain, which penetrates but does not sodden. Turn it over, and add more water in the same way until it has had as much as it can hold, when it will be all in nodules, and when put into the purifier, in a layer of at least 6 inches thick, it may again be watered as it lies; for, as it has not again to be touched, it can hold water and keep its shape, while more handling would convert it into paste.

A good test of when the lime has had water enough is when an inch or two in depth of water is found in the bottom of the dirty purifier—not necessarily water that has dropped through the lime, but water that has been brought forward in a state of vapour from previous purifiers, and condensed on the cold bottom.

As to the sifting of lime, after being wetted, I have abandoned that long ago, unless where it is bad, and much of it unslaked, because I think that the less handling it has the better. George Anderson.

Sir,—In reference to your remarks in your last, and to Mr. Forstall's letter in previous issue, permit me to disclaim the credit of having been the first to point out the utility of wetting and screening hydrate of lime for purification.

Wetting till the lime could be easily squeezed into a putty, and screening, were common practices in most of the gas-works in this neighbourhood, and probably in many other places in this country, as far back as 1853 at least. The use of "nodular" lime exclusively, means a good deal more than this, as any one may see who carefully reads that part of my paper. Yet I must apologize to your readers for the use of somewhat unguarded language. When I showed a sample of lime, "prepared in the usual way for purification," I had wet and screened hydrate in my hand and in my thoughts, I myself being most used to seeing it so

prepared. Mr. Forstall is not the less to be congratulated on having perceived and proved for himself the advantages of wetting and screening, notwithstanding the mystification of the books. WM. CLELAND.

Gas-Works, Linacre, near Liverpool, Sept. 10, 1875.

REVIVIFICATION OF FOUL LIME.

SIR,—In your issue of the 7th inst., page 358, you say, "What is now wanted is the means of revivifying foul lime," for purification of gas. Allow me to direct your readers attention to a paper read before the North British Association of Gas Managers, in July, 1874, by Mr. J. Gibb, of Armagh, and fully reported in the JOURNAL, vol. xxiv., p. 164, where the practical results of a number of years are given.

In the winter of 1873 I tried the same plan, and found a considerable saving in my lime account. Want of space, consequent on extensions and alterations of works, prevented me carrying out the plan more fully last winter, and as a result my lime account rose again.

Gas Company, Oswestry, Sept. 10, 1874. ANDREW GIBB.

NAPHTHA GAS.

SIR,—My attention having been attracted to your rather depreciatory remarks on "Naphtha Gas," as it is called in America, I desire, with your permission, to say a few words in answer to the question with which you conclude your observations and statements of facts as to the experience of the gas companies of the United States.

You ask, "If gas cannot be produced from petroleum at a cheap rate in Pennsylvania, where is it likely to be?" and my answer is contained in one word—"London."

I am not unacquainted with what has been going on, and is now being done, in this branch of industry in the United States; and I find, by an account given in the *Scientific American* of the 28th of last month, that the best result yet achieved in that go-ahead country, in the production of petroleum gas, is a cost of 2s. 9d. per 1000 feet, estimating the cost of petroleum spirit at 8d. per gallon, so as to put it on a par with my own standard of value in the Thames.

I am prepared to show the gas companies of London how to make it at 1s. 6d. per 1000 feet; and be assured that the gas engineers of the "old country" will not have to go to Pennsylvania to learn how to make cheap gas, nor how to turn the vast petroleum fields of the wide world to account as a means of economizing our coal supply, reducing the Sunday labour in our retort-houses, and obtaining every day in the week as much gas from one pair of hands as can be made by *eight*, by substituting steam and petroleum for coal.

As regards your having been told the spirit cost the "New Gas Company" 3s. per gallon, I have only to say you have been misinformed; and in due time *you*, and the shareholders of that concern, will be enlightened by a few facts from my pen. I have long since severed my official connexion with that undertaking, but shall have something to say about it by-and-bye. R. P. SPICE.

21, *Parliament Street, Westminster, Sept.* 11, 1875.

Legal Intelligence.

SOUTHAMPTON PETTY SESSIONS.—FRIDAY, SEPT. 10.

(*Before the* MAYOR, *Mr. Passenger, and a Bench of Magistrates.*)

PROCEEDINGS UNDER THE 20TH SECT. OF THE GAS-WORKS CLAUSES ACT, 1871, TO DETERMINE DISPUTED CONSUMPTION OF GAS.

The Southampton Gas Company were summoned, under the above-named statute, by James Ireland, draper, of Hanover Buildings, upon an information which stated that he and the company differed as to the quantity of gas supplied to and consumed by him between Dec. 31, 1874, and March 31, 1875. The 20th section of the Act provides that "the register of the meter shall be *primâ facie* evidence of the quantity of gas consumed, and in respect of which any rent is charged and sought to be recovered by the undertakers; provided always, that if the undertakers and the consumer differ as to the quantity consumed, such difference may be determined, upon the application of either party, by two justices, who may also order by which of the parties the costs of the proceedings before them shall be paid, and the decision of the justices shall be final and binding on all parties."

Mr. KILLBY appeared for the informant, the company being represented by Mr. Stocken, of the firm of Stocken and Jupp, London.

Mr. STOCKEN took a preliminay objection to the jurisdiction of the bench.

Mr. KILLBY maintained that the magistrates had power, under the section referred to, to adjudicate between the parties, and (as in the case reported last week, page 359) quoted the case in the Queen's Bench, *Scott v. The Commercial Gas Company*, where it was held that the Act under which Mr. Ireland was proceeding applied to all gas undertakings throughout the country, and not simply to companies incorporated after the passing of the Act; as also the case of the *New River Company v. Mather*, brought before the same tribunal, which, with the one exception that water instead of gas was the commodity supplied, was, he submitted, on all fours with the present proceedings, and wherein it was decided that magistrates and not the county court judge (in the present dispute the gas company were seeking to have the case settled at the county court) were the parties by whom the amount due should be determined.

Mr. STOCKEN, in reply, pointed out that there was this difference between a water and gas company—the former levied rates for the consumption, whilst the latter entered into a contract with the consumer, which contract moreover provided for the stoppage of a meter. Supposing it was a difference in the registering of a meter which had led to the dispute between the parties, he admitted the magistrates could have jurisdiction, but here the meter failing to register at all, the consumer was bound by his contract, and the company had a civil remedy against him in the county court if he failed to carry that out. He further pointed out not only that there was some slight discrepancy in the wording of the information and the actual words of the statute, but that the magistrates under the latter, even if they fixed upon a certain amount being due, had no power to order it to be paid.

Mr. KILLBY, in reply, submitted that the county court jurisdiction did not apply until after the magistrates had fixed the amount due; that the latter need not concern themselves how the sum was recovered, but merely carry out their duty as to fixing it, whilst also it might be assumed that there could be no unwillingness to pay on the part of a person who had himself instituted these proceedings, with a desire of arriving at the sum in which he was indebted to the company; and that the little difference in the wording of the summons might be a surplusage, but it in no way altered its effect.

The magistrates retired for a short time to consider the question raised, and upon their return the MAYOR said they had carefully considered the case, and had decided that they had no jurisdiction.

Mr. KILLBY asked for a case for the opinion of the superior court upon the legal points raised.

After some discussion, the magistrates said they would consider the application, and let Mr. Killby know the result.

Miscellaneous News.

METROPOLIS WATER SUPPLY.

The Registrar-General publishes the following returns of the average daily quantity of water supplied by the London water companies during the month of August, 1875. According to their returns, 125,186,508 gallons, or 568,780 cubic mètres of water (equal to about as many *tuns* by measure, *tons* by weight) were supplied daily; or 241 gallons (109·5 decalitres), rather more than a *ton* by weight, to each house, and 33·9 gallons (15·4 decalitres) to each person, against 35·1 gallons during August, 1874. According to returns of the London water companies made to the select committee on East London Water Bills (session 1867), it is estimated that, during the year 1866, about 82 per cent. of the total supply of water for all purposes was for domestic use. Applying this proportion to the total quantity supplied daily in the month of August, 1875, it may be estimated that about 102,652,937 gallons were used for domestic purposes, or about 27·8 gallons per day for each inhabitant, against 28·8 in the corresponding month of last year. This proportion varies from month to month, but the Registrar-General has no means of giving a more reliable estimate.

COMPANIES.	Number of Houses, &c., supplied in Aug., 1874.	Aug., 1875.	Aver. Daily Supply of Water in Gallons* during August, 1874.	August, 1875.
Total supply	512,540	519,569	127,649,728	125,186,508
From Thames	240,714	244,181	65,103,228	64,463,954
,, Lea and other Sources	271,826	275,388	62,546,500	60,722,554
THAMES.				
Chelsea	28,467	28,555	8,686,100	8,242,600
West Middlesex	46,151	47,090	10,356,837	10,636,411
Southwark and Vauxhall	79,704	80,188	18,973,610	19,270,000
Grand Junction	35,144	35,709	12,802,981	12,125,143
Lambeth	51,188	52,639	14,283,700	14,189,800
LEA AND OTHER SOURCES.				
New River	122,429	123,522	30,433,000	28,613,000
East London	106,459	107,851	24,995,600	24,789,000
Kent	42,938	44,015	7,117,900	7,320,554

* Including that for manufactures and for various purposes other than for domestic consumption.

Note.—The return for August, 1875, as compared with that for the corresponding month of 1874, shows an increase of 7029 houses, and a decrease of 2,463,220 gallons of water supplied daily.

Dr. Frankland, F.R.S., reports that the proportion of organic matter in the river waters supplied to the metropolis during August was much greater than during July. This is attributed to a recent fall of heavy rain before the collection of the samples. The Grand Junction Company delivered turbid water on the 9th of August, but, with this exception, all the samples examined were clear and transparent. Taking unity to represent the amount of organic impurity in a given volume of the Kent Company's water, the proportional amount in an equal volume of the water supplied by each of the other metropolitan companies was—New River, 2·4; Grand Junction, 4·8; Chelsea and East London, 4·9; Southwark, 5·6; Lambeth, 5·8; and West Middlesex, 6·1.

HASTINGS AND ST. LEONARD'S GAS COMPANY.

The Half-Yearly Meeting was held on Thursday, the 2nd inst.—Mr. G. SCRIVENS in the chair.

The following report was taken as read:—

Your directors have now to report that they have laid several pieces of new main during the present half year, the following being the chief districts in which they are laid—viz., Silchester Road, Carisbrook Road, Mount Pleasant Road, Emmanuel Road, South Terrace, Priory Garden Road, and Baldslow Road; and they, with great pleasure, point to these extensions as indicative of the general increase and prosperity of the company's business. It has been found that the services in Robertson Street and Eversfield Place were in a very bad condition, and the whole of them have, in consequence, during the summer, been taken up and replaced with new ones.

The price of coal has sufficiently fallen to warrant your directors in giving notice of a reduction in the price of gas to 4s. 7d. per 1000 cubic feet within the borough boundary. The reduction to take place after the end of the present year.

The accounts, duly audited, leave a balance of £4057 0s. 7d., which, with the balance of £37 19s. 6d. brought forward from the last half year, leaves the sum of £4095 0s. 1d. to be dealt with by the shareholders; and it is proposed to pay a dividend at the rate of 10 per cent. per annum on the paid-up £25 shares; a dividend at the rate of 7 per cent. per annum on the £20 paid shares; and interest at the rate of 5 per cent. on the new £12 paid preference shares. It is also proposed to carry £700 to the reserve-fund, leaving £57 10s. 1d. to be carried on to the next half year.

The CHAIRMAN expressed a hope that the report would be found satisfactory to the shareholders, and alluded to the fall in the price of coal, which would justify the directors in making the reduction in the price of gas proposed. The directors still had to grapple with the coke difficulty, and found themselves unable to realize what they anticipated getting for it. They had got rid of the stock in the yard, in view of the season which was coming on, in the best way they could. The fact was there was more coke manufactured than there was a demand for. The works were in good condition, and all parts of the establishment and mains were in such order that they were ready to meet the demand for, and manufacture a largely increased supply of, gas. He hoped his fellow-shareholders would be satisfied with that state of things, and concluded by moving the adoption of the report.

Mr. WM. HALLAWAY seconded the resolution, which was adopted.

The retiring directors and auditor were re-elected, and the proceedings terminated.

LEICESTER GAS COMPANY.

The Ordinary General Meeting was held on Thursday, the 2nd inst.—Mr. W. E. HUTCHINSON in the chair.

The SECRETARY (Mr. W. Billson) read the following report:—

The gas and meter rental for the half year ending on the 30th of June last amounted to £32,165 7s. 6d., showing an increase as compared with the corresponding half year of 1874 of £4767 19s. 8d.

The balance to the credit of the revenue is £7980 5s. 2d., and the directors recommend that dividends be declared of 11s. 6d. per share on each A share, 7s. 6d. per share on each B share, and 4s. 2d. per share upon each C share, such last-mentioned sum being at the rate of 7 per cent. per annum on the amount paid-up on such shares.

The proprietors were informed at the last general meeting that a change was then contemplated in the mode of carrying on the undertaking. This change took effect on the 1st day of January last. The directors have every reason to be satisfied with the results of the half year's working.

The directors have to regret the loss by death of two of their number since last meeting. Mr. Thomas Paget and Mr. William Burley had both been members of the board for many years, and had rendered valuable service to the company. Mr. Alfred Paget has been elected to a seat on the board in the place of Mr. Thomas Paget, and Mr. John Higginson in the place of Mr. William Burley.

The duties of the auditors of the company have been much increased by the change in the management of the undertaking and of the mode in which the various accounts are now required to be kept. The directors recommend that the salary of each of those gentlemen be increased from £20 per annum to £30 per annum, commencing from the 30th day of June last.

The directors who retire by rotation are Messrs. William Smith Frisby, William Agar, and Alfred Paget, all of whom are eligible for re-election.

The CHAIRMAN said that when the directors had the pleasure of meeting the shareholders at the last half-yearly assembly, they informed them that it was in contemplation to make a material alteration in the management of the affairs of the company. That alteration took place on the 1st of January last, and it consisted broadly in taking over the structure, the machinery, and the plant, and also the stock of gas and the stock of coal, then the property of the contractors. The amount of the valuation was very considerable, being something like £20,000, for things which had previously been found by the contractors in the course of their business as manufacturers of gas for the company. They agreed upon an efficient man to decide the value, and both parties were satisfied with the award. The change was completed by the appointment of Messrs. George and Charles Robinson, as the joint managers of the undertaking, so that the company now had the entire control of the works, and of the manufacture of the gas. They had had six months experience of the working of the new arrangement, and were well satisfied with it. They had been enabled to supply the public with an excellent quality of gas—gas which, for its illuminating power, gave general satisfaction, and at the same time had been enabled to earn the maximum dividend which they were allowed by their various Acts of Parliament, besides carrying over a considerable balance to the credit of the current half year. They would, perhaps, have noticed that a great alteration had taken place in the form of the accounts, which were much more voluminous, and gave a much greater amount of information than those which were formerly rendered. They were put before them in the form now prescribed for all gas companies—the form contained in the Gas-Works Clauses Act of 1871. Of course, from the change which had been made, it was not so easy to compare the items with those which the directors rendered a year ago, but after the close of the present year the shareholders and the public would have the means of doing that. The alteration had entailed a great deal more labour, and had involved a great deal more time on the part of the gentlemen who audited the accounts than was previously the case. The capital account showed that there had been expended during the half year £4187; and of this amount £2832 had been expended in the taking from the contractors the structures, machines, and working plant which were necessary to carry out the manufacture of gas. They had spent, in laying new mains in new streets, rendered necessary by the extraordinary and rapid growth of the town, the sum of £718, and from the increase of consumers they were obliged to increase their stock of meters; and the amount expended in the half year had been £516. In order to meet this expenditure, and to have working capital for carrying on the concern, the directors had, as those present were aware, been obliged to make calls upon the shareholders, but he supposed if they got 7 per cent. they would not be very angry with them for doing so. The revenue account was satisfactory, and he was happy to state that the works were in very excellent order. Considerable additions were going on, and they were filling the new retort-house with retorts in order to be able to supply the ever-increasing demand for gas. He could hardly sit down without alluding to the long and mutually beneficial connexion which had existed between the Messrs. Robinson and the company. The directors considered themselves fortunate in being able to engage the services of Messrs. George and Charles Robinson, they having for many years been engaged upon the work, discharging their duties to the satisfaction of the directors and with credit to themselves. In conclusion, he moved the adoption of the report.

Mr. W. S. FRISBY seconded the motion, which was carried.

On the motion of the CHAIRMAN, seconded by Mr. FRISBY, the following resolutions were agreed to:—"That a dividend be, and is declared of 11s. 6d. per share on each A share, 7s. 6d. per share on each B share, and 4s. 2d. per share on each C share." And "That the salary of each of the auditors be increased from £20 per annum to £30 per annum, such increase to commence from the 30th day of June."

The retiring directors were re-elected, and the proceedings closed with a vote of thanks to the chairman.

FALMOUTH GAS COMPANY.

The Annual Meeting was held on Monday, the 6th inst.—Mr. R. M. TWEEDY in the chair.

The SECRETARY (Mr. R. J. Lukey) read the advertisement convening the meeting. The directors report, which was taken as read, was as follows:—"The property of the company continues to improve under the careful management of Mr. Harris. The consumption of gas during the year has increased, but at the same time there has also been a small addition to the leakage. Your manager has devoted a great amount of time in testing the mains and services to discover the cause of this loss, and reports that he finds them defective throughout the whole district. He has opened and examined more than 1500 yards of mains and has found it necessary to replace over 1000 yards with new pipes; to thoroughly examine and test the whole of the company's mains will take a considerable time, and it is anticipated the cost of the new pipes to replace those which are defective will be heavy. The charge for repairs to the company's house property has been large during the year, and it is feared that the outlay on it for some years will have to be considerable. By the new assessment the rating of the company's property has been largely increased, but not to the extent that was at first proposed, for, on appeal, the amount was reduced from £455 to £262. The continued fall in the price of coal again enables the directors to announce a further reduction of 5d. per 1000 feet in the price of gas from the 29th of September next, which, with the discount, reduces the net price to 4s. 10½d. per 1000 feet; this compares favourably with the price charged by other gas companies in the county. From the undivided profit your directors recommend the payment of a dividend for the year at the rate of £6 5s. per cent., free of income-tax, which will amount to £672; the transfer of £83 to the new works account and the balance of £127 to a suspense account."

The CHAIRMAN, in moving the adoption of the report, commented upon the decrease in the leakage, which had been reduced through the energy of Mr. Harris, the manager, by whose exertions there had already been a great saving effected in Woodlane Terrace alone. The works were in a very satisfactory condition, and he was glad to see an increase in the number of street-lamps in the parish of Falmouth.

Mr. S. JACOBS seconded the adoption of the report, and the motion was carried.

Mr. J. MEAD said he considered the leakage excessive, but in reply to a question stated that he could not then say what the leakage was when he sold the works to the company.

Mr. R. R. BROAD said he considered the time had arrived for the shareholders to pay for the services of the directors, who had worked for 10 years for nothing, and moved that for the future the directors be paid for their services.

The CHAIRMAN referred to the fact that the dividend had increased from 2½ to 6¼ per cent., and said that the directors thought they would be entitled to some consideration when the dividend rose to 10 per cent. He thought that there would be a larger dividend next year, but did not think it would reach 10 per cent.

After some conversation, at the suggestion of the CHAIRMAN it was decided to postpone the matter until the next annual meeting, and Messrs. BROAD and ROGERS stated that they would then move a resolution in favour of paying for the services of the directors.

A dividend of 6¼ per cent., amounting to £672, was declared. Messrs. W. Selley and J. P. Dunning were re-elected directors, and Messrs. W. Phillips and W. H. Williams were re-elected auditors. A vote of thanks to the chairman for presiding, and to the board of directors for their services during the past year, terminated the meeting.

HARTLEPOOL GAS AND WATER COMPANY.

The Ordinary Annual General Meeting, followed by an Extraordinary Meeting, was held on Tuesday, Aug. 31—Mr. T. R. HOLMES in the chair.

The SECRETARY (Mr. Thomas Trewhitt) having read the notice convening the meeting, the report of the directors was presented.

The divisible balance is £14,590 11s. 8d., out of which your directors recommend the payment of a dividend for the last half year at the rate of 10 per cent. per annum on the old or "A" shares; at the rate of 7½ per cent. per annum on the "B" shares; and at the rate of 7 per cent. per annum on the remaining paid-up "C" capital of the company; in all cases less income-tax.

The enlargement of the purifiers at the West Hartlepool Gas-Works, referred to in last report, is fast approaching completion, and will be available for the ensuing winter supply, and capable of purifying one million cubic feet of gas per day; the enlargement of the retort-houses at the above works has also been found necessary, and is now in progress.

The extension of the works at Hurworth is progressing satisfactorily.

"*To the Directors of the Hartlepool Gas and Water Company.*

"Gentlemen,—We have to report the satisfactory condition of the water-works generally. The enlargement of the storeage reservoir at Hurworth Burn is making steady progress. The extension of the embankment and the new by-channel are in a forward state; but some delay has arisen in consequence of our having been refused possession of certain parts of the land required for the works until the compulsory powers of the Act were put in force. These and other temporary difficulties have now been satisfactorily disposed of, and we hope to make such further progress during the present year as will secure a largely increased amount of storeage in that reservoir. The land for the additional reservoir at Hart has been purchased, and the works there may be proceeded with as soon as the necessity arises. We have the honour to be, gentlemen, your most obedient servants, "MARTIN AND FENWICK.

"1, *Park Place, Leeds, Aug.* 10, 1875."

The directors now find it imperative to allocate the remaining share capital of the company, and with this view have convened an extraordinary meeting of the shareholders, to be held immediately after the business of the general meeting, on the 31st instant, is disposed of.

The retiring directors this year, who are eligible for re-election, are Messrs. Grey and Fisher, and the retiring auditor is Mr. Henry Taylor, who offers himself for re-election.

The CHAIRMAN, in moving that the report be approved and the dividend, therein recommended, declared, said he was happy to be able to congratulate the shareholders on the continued prosperity of the company. They would learn from the report and balance-sheet that the entire concern stood in a most happy position. It was not necessary that he should enter into detail, as all the facts were before them; and he would content himself with saying that everything during the past year had proved highly satisfactory.

Mr. J. LAWRENSON seconded the motion, which was adopted unanimously.

The retiring directors and auditor were re-elected, and on the motion of the CHAIRMAN, seconded by Mr. FENWICK, the remuneration of the auditors was augmented by the sum of £10 per annum each, making for both a total of £50 a year.

This concluded the business of the ordinary meeting.

An extraordinary meeting was then held, "for the purpose of determining and as to the creating and issuing of the remaining new shares, the amount of calls to be made thereon, and the time when such calls shall be made and paid."

The following resolutions were submitted to the shareholders and agreed to:—"That 4278 new shares of £5 each be allotted to the present shareholders, in the proportion of one new share to every eight now held, and the remaining unallotted shares be sold by public auction, and the profits arising from such sale be credited to the company in proportion to the capital invested in each department." "That the first call of such newly-allotted shares, of £1 per share, be made payable on or before the 18th of October next," and "That the amount of all subsequent calls on the newly-allotted shares, and all calls on the shares sold by public auction, be fixed in such manner as the directors may determine and as the interests of the company may demand."

Mr. FENWICK finally proposed a vote of thanks to the chairman; and in so doing said that Mr. Holmes was so largely interested in the undertaking that personal motives alone would be a sufficient incentive to the proper discharge of his duties, to say nothing of his desire to serve the great body of the shareholders to the best of his ability.

Mr. DOBING seconded the motion, which was carried amid general expressions of approval.

The CHAIRMAN, in response, expressed a hope that the concern would continue to thrive, and that the next half-yearly meeting of shareholders would be as agreeable as the present.

The proceedings then terminated.

SUNDERLAND AND SOUTH SHIELDS WATER COMPANY.

An Extraordinary Meeting, for the purpose of authorizing the directors to issue the capital granted by the company's Act of 1868, was held on Friday, the 3rd inst.—Mr. R. VINT in the chair.

The CHAIRMAN said that for some time past the company had been making large extensions to their plant, and they now wished to raise additional capital by a fresh issue of shares. The powers granted to the company, up to and including their Act of 1859, enabled them to issue 53,500 shares, giving a nominal capital of £267,500, the whole of which sum had been expended in the construction of works. But, in addition to this sum, they had raised by the sale of shares by auction, premiums to the extent of more than £126,000, which had also been disbursed over works. Having exhausted all their powers under the previous Acts, they had now come to the last Act obtained by the company—namely, that of 1868—which enabled them to raise £150,000 of additional capital, or issue, say, 30,000 shares of the nominal value of £5, and did not require them to sell those shares, but allowed them to be allotted amongst the present proprietors in rateable proportion. Connected with the power of allotment there were certain conditions for the benefit of the holders. No call could exceed the fifth part of a share; they could never call up at one time more than 20s. per share, and there must be a period of at least three months between each call, so that not more than three-fifths of a share should be called up in 12 months. While the full amount of the shares remained unpaid, the owners could receive 5 per cent. interest on the amount paid up, but on the shares being converted into stock on their being fully paid up, they could receive interest at the rate of 7 per cent., but never more. The question arose whether it was desirable to allot the whole of the shares at once, or only some portion—say, one-third—making a further allotment at a future time. The directors went into the question very carefully, and found that if they allotted only one-third, there would be one share for every six, so that those who had only five, or any less number of shares, would receive no benefit. They considered this was not desirable, and came to the conclusion that, under all the circumstances, it would be best to allot the whole of the shares at once, calling up the money as the exigencies of the company required them to do so. If this plan was adopted, every person possessing two old shares could get a new one, while every one having 100 shares would get 56 new ones, that being the per centage of new to old shares. He then moved the following resolution:—"That the new capital authorized to be raised by the Sunderland and South Shields Water Act, 1868, being £150,000, be raised by the creation of 30,000 shares of £5 each, and that the directors of the company be and are hereby authorized to issue, allot, dispose of, and distribute such new shares (subject to the provisions of the said Act) amongst the shareholders of the company in such manner, upon such terms in all respects, and subject to such provisions and restrictions, and with such rights as they shall from time to time direct, authorize, or determine."

Mr. ANDERSON seconded the motion, which was unanimously adopted, and the meeting terminated.

WALSALL GAS SUPPLY.

A Special Meeting of the Walsall Town Council was held on Thursday last—the MAYOR in the chair—for the purpose of considering and determining whether or not the Council should promote a Bill in Parliament to effect the following objects—viz.:

1. To authorize the mayor, aldermen, and burgesses of the borough of Walsall to purchase from the mayor, aldermen, and burgesses of the borough of Birmingham, and acquire the undertaking, lands, buildings, works, mains, pipes, plant, meters, fittings, and effects within the borough of Walsall, now or immediately before the passing of the Birmingham (Corporation) Gas Act, 1875, belonging to the Birmingham and Staffordshire Gaslight Company, and also any necessary extensions made before the completion of the said purchase, and to exercise the rights, powers, and privileges connected therewith, in consideration of an annual payment in perpetuity of £1300, and of the repayment of the capital expended in such necessary extensions, with power to redeem such annual payment for such capital sum as may at any time hereafter be agreed upon; and also from time to time to construct such additional works as may be necessary to furnish an adequate supply of gas to the present and future inhabitants of the borough.
2. To transfer to the mayor, aldermen, and burgesses of Walsall the whole of the gas-works and gas undertaking, including lands, buildings, works, mains, pipes, plant, meters, fittings, debts, and effects, and all rights and powers relating thereto, of the commissioners acting in execution of the Walsall Improvement and Market Act, 1848; and also to make provision for the payment by the said mayor, aldermen, and burgesses of Walsall of the whole of the mortgage and other debts of every class owing by the said commissioners.
3. To add to and include in the municipal borough of Walsall that portion of the parish of Rushall which is situate within the district of the said commissioners.

Mr. R. W. BROWNHILL, in proposing a resolution in favour of the first of these objects, said that the Birmingham and Staffordshire Gas Company had 21 miles of mains in Walsall, worth about £14,000; meters, tar-wells, fittings, and sundries, estimated to be worth £6000; and the offices in Bridge Street, estimated to be worth £5000; or £25,000 in all. As to the probability of this new undertaking paying, as compared with the Walsall works, taking the last five years (three of which were very unfavourable), the Walsall works, not taking capital into account, made a gross profit of £15,500, during these five years, after keeping the whole of the works up to their full value out of revenue. The total make of gas during these five years would be about 500 million feet, and if the £15,500 was divided by that amount, it would give a profit of £31 per million. The estimated quantity of gas that would be supplied by the Birmingham Corporation up to 1877, when the Walsall Corporation would have to take over the property, was 60 million feet, which, at £31 per million, would give a gross profit of £1860. If the Walsall Corporation disposed of the company's offices in Bridge Street (which would not be wanted), say for £5000, that would produce £200 a year, and reduce the amount to be paid out of the gas funds to £1100. Deducting this £1100 from the £1860 gross profit, there remained £760, or the interest on a capital of £19,000, which was more than would be required to erect new gas-works to produce the 60 million feet of gas. Further, Walsall would have the advantage of the surplus main power of the Birmingham Corporation—mains worth £7000 to the Walsall authorities; because otherwise they would have at once to break up the streets to put down mains similar to these, if they were not acquired.

Mr. HOLDEN seconded the proposition, and said that, knowing the progress which the gas-works had made during the last few years, he was satisfied that Walsall had made a good bargain, notwithstanding all that the Mayor of Birmingham might say as to the advantages on his side of the matter.

Mr. DEELEY, on the other hand, considered that Walsall would not make a good bargain if the proposed arrangement were carried out; and was sure that, if the authorities had only waited for a time, they might have had the property on more favourable terms, because the Mayor of Birmingham and his committees no doubt knew that their business in Walsall was not a good one. The Walsall authorities would have done better if they had turned their attention to providing a supply of water for the town.

The MAYOR replied, contending that the arrangement between the Birmingham Corporation and the Walsall Corporation was a most advantageous one for the latter.

The proposition was then agreed to, with only one dissentient.

Mr. LINDOP then proposed, and Mr. RUSSELL seconded, a proposition in favour of the second object of the proposed bill, which was agreed to.

The TOWN-CLERK, in the course of a discussion which followed, said that, taking the standard upon which the Birmingham Corporation had bought, the Walsall Gas-Works, upon which £52,000 had been spent, were worth £100,000.

Resolutions were also passed providing for the cost of the bill; and for the town-clerk, in concert with the Parliamentary Committee, taking all necessary steps for its promotion.

SWANSEA GAS SUPPLY.

At the Monthly Meeting of the Swansea Town Council, on Wednesday last—the MAYOR (Mr. Yeo) presiding,

A letter from the gas company was read, announcing that from the 1st prox. the price of gas to the Urban Sanitary Authority would be reduced 6d. per 1000 cubic feet, and to all private consumers in the town and borough 3d. per 1000.

The TOWN-CLERK read the minutes of the Gas Committee, which stated that, according to plans, specifications, and estimates which had been prepared for them, new gas-works could be erected for the sum of £48,000. They, therefore, recommended that application be made forthwith to the Local Government Board for power to borrow the necessary money, and that the sum of £100 be paid to the person by whom the plans had been prepared, on account of his charges, which, in the whole, amount to £200.

Alderman JENKINS, in moving the adoption of the minutes, said the plans laid on the table represented works capable of producing 200 million cubic feet of gas per annum, and, with a little additional outlay, they would produce very much more. The estimate was divided into three parts. The first part, or that referring to machinery and apparatus, would cost £20,310. Then there would be 66,600 yards of pipes, which would amount to about £22,500. The service-pipes, meters, &c., would amount to £5500; making a total £48,310. The quantity of pipes would have to extend over 38 miles of ground; and, instead of laying down large pipes in the middle of the roadways, it was proposed to lay two smaller pipes, one on each side of the road, near the kerbstone. The cost of this would not exceed the expense of laying one large pipe in the middle of the road, and it would have the advantage of requiring a smaller outlay for service-pipes, and would not prevent traffic in the streets during the laying. He had proved, by statistics which he had laid before the council previously, that there was no reason why gas could not be produced in Swansea at 2s. 6d., or at the outside 2s. 9d. per 1000 feet. At a very low estimate the gas consumed was 100 million feet per annum, and a reduction of price to 2s. 6d. per 1000 feet would mean a saving of £7500 per annum. He did not say that if the corporation erected their own works they would supply the whole of the inhabitants; but he did say that it was not reasonable that if the people of the town were supplied with gas at the rate of 2s. 6d. per 1000 feet, those who lived a little outside the town and franchise would be content to pay a higher rate. Consequently he assumed that the whole of them would receive their gas at 2s. 6d. per 1000 feet, and the competition in gas, as in everything else, would be salutary in its effects, for they would be able to obtain the article at its minimum cost, which they could not obtain while the present monopoly lasted. He did not mean to cast a reflection upon any one, but he could not close his eyes to the fact that the company had always carried things with a high hand. He contended that in the case of an article of such general use and necessity, a monopoly ought not to be allowed to remain in the hands of private individuals. They had been informed that day of a reduction of 3d. per 1000 feet to private, and 6d. per 1000 feet to public consumers, but this was only a moiety of the reduction that ought to take place. It ought to be reduced 1s. per 1000 feet to meet the justice of the case. Gas ought to be supplied at the lowest possible cost, as would be the case under economical management if the works were in the hands of the corporation. One of the directors of the Swansea Gas Company had told him he was sorry the present reduction was not a larger one, but the fact was they had made a bad contract for coal, and consequently could not lower it. What did that mean? Why, that if the gas company made a bad contract, they had the public purse to make up the difference—they would come to the public purse to indemnify themselves for the bad management. Now he maintained that to enter into a large contract in the face of a falling market was a thing that no gentleman of experience would have done; and further, it was a most unjust thing that the public should be made to pay for the indiscretions of those in authority at the gas-works. The larger the consumption of gas the cheaper it could be produced. If gas were sold in Swansea at about 2s. 6d. per 1000 feet, large numbers of people would use it for domestic purposes, whereas now they were deterred by the high price. It had been asked whether he could point to a single case in which a corporation managed their gas-works economically. He accepted the challenge, and answered it in this way, though the question was a most puerile one. In Manchester they had had the gas-works in the hands of the corporation since 1825; gas was supplied to the town almost as cheaply as any town in England, and the Gas Committee had been enabled to give a large proportion of the profits towards reducing the rates. In the year 1873 they had given no less than £58,603 towards reducing the rates, and put aside £22,849 towards the depreciation of plant, so that the total profits were £81,452. In 13 years they had applied £319,524 out of their profits to the reduction of rates. On a former occasion he referred to Walsall, where the corporation had the works in their own hands. Gas had been supplied there during the high prices of coal at 2s. 3d. per 1000 feet, and they had succeeded in applying £2000 and £3000 and £4000 towards the reduction of rates.

Alderman FORD seconded the motion.

Mr. EVANS moved, as an amendment, that the consideration of the minutes be deferred for a fortnight, and be then considered by a special meeting of the council. He thought it possible that, if the gas company found the council were determined to do something in the matter, they might make some further reduction in their rates. Moreover, he objected to the discussion of so important a question as the erection of new works in so thinly attended a council. Notice of the subject should be sent to each member, and a special day appointed for its consideration.

Mr. ELFORD seconded the amendment, and quoted, from communications he had received, some figures as to the cost of the supply of gas in several towns. In one case, he said, his correspondent stated that they had not placed the gas supply in the hands of the corporation, because they feared "jobbery." For himself, he thought the agitation of this matter had been productive of much good, and, if gas were reduced in Swansea to 3s. 6d. per 1000 feet, he would not be dissatisfied. He did not believe in the corporation having the gas-works in their own hands; they had quite sufficient to do now with the water and sewers, &c., &c. He did not think it would be for the benefit of the inhabitants.

The MAYOR also suggested that, under the circumstances, the discussion of the question should be adjourned to a special meeting of the council, which he was prepared to call for that purpose.

Mr. J. ROGERS moved a second amendment, to the effect that it was inexpedient to proceed further with the discussion of the question, until the figures quoted by Alderman Jenkins, from the estimates laid before the committee, had been verified by some respectable gas engineer. It was nonsense to say that gas could be produced at a certain price, without specifying the conditions. A great deal had been said about Walsall, and that it supplied gas to customers at 2s. 2d. per 1000 feet; but there were special circumstances. The Corporation of Walsall had a capital of only £11,000, on which they paid 5 per cent., and gave all the remaining profits to their customers. Now Walsall, with its capital of £11,000, was a very different thing from Swansea with the capital that would be needed here. They ought not to be compared for a moment. It was an unfortunate thing for Swansea that a bad bargain had been made by their predecessors; but many persons had been induced to invest their money in the gas-works on the understanding that they would receive a certain rate of dividend, and their interests ought not to be ignored. There were certain things that must be considered before they went in for corporation gas-works. If they could get gas supplied to them at a fair and reasonable rate, they ought to respect the present monopoly. It was simply a question of what was a fair price. He did not think the public of Swansea ought to be bound down for all time, from generation to generation, to pay 10 per cent. on the original capital of the gas company, nor did he think they should respect the vested interests of those who received 7½ per cent. for their investment; but he thought the gas company ought to reborrow their money at 4 per cent. If they sacrificed a little they would save much, and he was disposed to think that, if the matter were fairly represented to them, it could be done. If the company were to reduce their price to a moderate rate, the Corporation of Swansea would not be justified in entering upon a new undertaking of this sort.

Alderman JENKINS, referring to the first remark of the last speaker, said that a contractor of undoubted position and respectability would undertake to carry out the new works at a sum somewhat under the estimate laid before the committee.

Mr. ROGERS replied that that was very possible; but what guarantee had they that this contractor might not feather his own nest? He wanted the opinion of a known respectable gas engineer. This matter could not be gone into until these estimates had been verified by a gas engineer of known respectability, and if any discrepancy should arise, then another engineer should be had. He (Mr. Rogers) also feared that if the works were in the hands of the corporation, "jobbery" would arise. There was no doubt that the company manufactured their gas in the most scientific manner, and as to the ability of their gas engineer, there was no more clever gas engineer in the United Kingdom than Mr. Thornton Andrews. He had been exceedingly sorry to hear Alderman Jenkins throw out a hint derogatory to the management of that gentleman. He did not think the alderman was justified in so doing, as Mr. Andrews was a most valued servant of the gas company. If Mr. Andrews were allowed to carry out his management, and were perhaps a little less trammelled than he was by those above him in office, the price of gas would be cheaper in Swansea.

Alderman BROWN: The effect of the amendment is that the matter should be adjourned.

Mr. ROGERS: And that the estimates should be checked by an independent gas engineer of undoubted respectability.

Alderman BROWN hoped that the good sense of the council would see fit to have the discussion adjourned to a special meeting. He agreed with what Mr. James Rogers had said, particularly the remarks relative to the capacity and high character of the gas manager, Mr. Thornton Andrews; but it had struck him that the inference to be drawn from all this was very different from what at first appeared. The argument that Mr. Thornton Andrews was so highly capable of carrying on the management of gas-works was an argument in favour of the Swansea people having cheap gas. If the company would supply the town with gas at moderately remunerative prices, he for one would not wish to take the monopoly out of their hands.

Alderman PHILLIPS, although chairman of the gas company, claimed to be allowed to speak on the motion. He complained of the proceedings of the Gas Committee. He said they had asked for unusual powers, powers that he never

remembered being asked for by any single committee in the whole history of his connexion with the corporation—powers to go into the whole question, to discuss it in secret from time to time, to prepare plans and engage an engineer—one or two—for this was not the first engineer that had been engaged. Another had been engaged, and a large sum of money paid, but unfortunately that engineer, who was a respectable gentleman, had passed away to another world. Such powers the committee had taken and made use of. He hoped he should say nothing violent when he said that the committee, having got this question in their hands for so many months, meeting from time to time without reporting to the council, now brought up this scheme, and tried to get the council to affirm it, without further having an opportunity of considering it. He remembered the passing of the Swansea Gas Act in 1861. He was then a member of the council, and was interested in the gas company. At that time the Corporation of Swansea appointed a committee to watch the progress of the bill through Parliament. The committee was composed of very influential gentlemen, and they were instructed to get inserted into the company's Act certain clauses securing the interests of the corporation and the public, and every one of these clauses, suggested by the corporation through its representatives in the House of Commons, was inserted in the Act; therefore, the Act was quite as much a Swansea Corporation Act as a Gas Act. As to the price of gas, they knew that the maximum was 4s. per 1000 feet. During the three years of the high price of coal, the company were in the position of not being able to raise their price above 4s. Other companies had had the power to charge as high as 5s. and 6s. The majority of those who had no power to go above 4s. had gone to the Board of Trade, and applied for power to raise the price above the amount specified in their Act of Parliament. But the Swansea Gas Company had not made such an application. They had drawn upon their resources, and had given the public the benefit. Had they done as other companies had done, they would have made application to increase their price, and would now have been in the position of receiving enhanced profits for that time, and they would have been now able to reduce the price of gas below the amount they now proposed to reduce it. At that time the result of giving the public of Swansea the benefit of the price was that the shareholders had to be content with a less dividend than the Act allowed them. Much had been said about the company throwing obstacles in the way of the corporation, and that their application had been met unhandsomely and obstructively. He said this could not be correct. If any obstruction had taken place, it must have been on the other side. The corporation had applied for an extension of mains, and the company had extended the mains into districts which would not be remunerative. There were miles and miles of such mains laid down in the outlying districts. In consequence of the corporation appointing an analyst and gas inspector, the company, in order to meet the demand for purity and quantity, had been obliged to make extensions amounting to £20,000 or £30,000. As to obstruction, he might mention that, when the company applied for permission to lay down a main across the old Rope Walk, the corporation had made their permission so restrictive that the conditions could not be complied with, and the company had been compelled to lay pipes through Rutland Street, at a cost of about £10,000. Had facilities been given by the corporation the gas would have been cheaper. No man knew better than Alderman Jenkins that one man was as liable as another to make a bad contract, and the manager of the gas-works had been obliged to make a contract which was a bad one, and from which the company now suffered. If the corporation had gas-works of their own, they also would be liable to make bad contracts. Much had been said about the large dividends paid by the company. The 10 per cent., which was paid on £6000 only, had been unfairly magnified in this way. Those who had received 10 per cent. on the £6000 were the original shareholders; and, taking into consideration the whole of the time they had held the shares, the dividend did not exceed 5 per cent. Looked at from an honest point of view, he thought that 10 per cent. on £6000 ought not to be hacked about as it had been. When the works were completely developed, he hoped the company would be able to supply gas to public and private consumers at a price equal to that of any company in the United Kingdom.

Mr. HARVEY said he thought the question had been sufficiently ventilated, and that there was no necessity for an adjournment.

Mr. DAVIES said he should be satisfied with the reduction that had been announced if there was any guarantee that occasion would not be taken to raise it again.

After some further discussion, the amendment moved by Mr. Rogers was withdrawn, and the amendment that further discussion be adjourned to a special meeting was then put to the meeting. Six members were for and six against its adoption, and the mayor gave his casting vote in favour of the adjournment, which was then put as the substantive resolution and carried.

BRITISH ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE.

The Forty-Fifth Annual Meeting of this Association has just been held in the City of Bristol, and from the report of the proceedings we give some extracts which will be of interest to our readers.

At the first sitting, on Wednesday, the 25th of August, the PRESIDENT (Sir John Hawkshaw) delivered his inaugural address. After referring to the rise and progress of engineering, the early use of iron and ancient building operations, he proceeded to speak of

ANCIENT WATER-WORKS.

Egypt was probably far better irrigated in the days of the Pharaohs than it is now. To those unacquainted with the difficulties which must be met with and overcome before a successful system of irrigation can be carried out, even in countries in which the physical conditions are favourable, it may appear that nothing more is required than an adequate supply of unskilled labour. Far more than this was required. The Egyptians had some knowledge of surveying, for Eustathius says they recorded their marches on maps (Rawlinson's "Herodotus," vol. ii., p. 278, 2nd edit.); but such knowledge was probably in those days very limited, and it required no ordinary grasp of mind to see the utility of such extensive works as were carried out in Egypt and Mesopotamia, and, having seen the utility, to successfully design and execute them. To cite one in Egypt—Lake Mœris, of which the remains have been explored by M. Linant, was a reservoir made by one of the Pharaohs, and supplied by the flood waters of the Nile. It was 150 square miles in extent, and was retained by a bank or dam 60 yards wide and 10 high, which can be traced for a distance of 13 miles. This reservoir was capable of irrigating 1200 square miles of country. (M. Linant's "Mémoire sur le lac Mœris.") No work of this class has been undertaken on so vast a scale since, even in these days of great works. The prosperity of Egypt was in so great a measure dependent on its great river, that we should expect that the Egyptians, a people so advanced in art and science, would, at an early period, have made themselves acquainted with its *régime*. We know that they carefully registered the height of the annual rise of its waters; such registers still remain inscribed on the rocks on the banks of the Nile, with the name of the king in whose reign they were made (Lepsius' "Discoveries in Egypt," &c., p. 268). The people of Mesopotamia were equally observant of the *régime* of their great rivers, and took advantage, in designing their canals, of the different periods in the rising of the Tigris and Euphrates. A special officer was appointed in Babylon, whose duty it was to measure the rise of the river; and he is mentioned in an inscription found in the ruins of that city, as recording the height of the water in the Temple of Bel (Smith's "Assyrian Discoveries," pp. 395-7, 2nd edit.). The Assyrians, who had a far more difficult country to deal with, owing to its rocky and uneven surface, showed even greater skill than the Babylonians in forming their canals, tunnelling through rock, and building dams of masonry across the Euphrates. While the greater number of these canals in Egypt and Mesopotamia were made for the purpose of irrigation, others seem to have been made to serve at the same time for navigation. Such was the canal which effected a junction between the Mediterranean and the Red Sea, which was a remarkable work, having regard to the requirements of the age in which it was made. Its length was about 80 miles; its width admitted of two triremes passing one another (Herodotus, book ii., c. clviii.). At least one of the navigable canals of Babylonia, attributed to Nebuchadnezzar, can compare in extent with any work of later times. I believe Sir H. Rawlinson has traced the canal to which I allude throughout the greater part of its course, from Hit on the Euphrates to the Persian Gulf, a distance of between 400 and 500 miles (Rawlinson's "Herodotus," vol. i. p., 420, 2nd edit.). It is a proof of the estimation in which such works were held in Babylonia and Assyria that among the titles of the god Vul were those of "Lord of Canals," and "The Establisher of Irrigation Works" (Ibid., p. 498). The springs of knowledge which had flowed so long in Babylonia and Assyria were dried up at an early period. With the fall of Babylon and destruction of Nineveh, the settled population of the fertile plains around them disappeared, and that which was desert before man led the waters over it became desert again, affording a wide field for, and one well worthy of, the labours of engineers to come.

The next topics touched upon the progress of engineering in ancient Greece and Rome, and throughout Europe during the dark and middle ages. It then proceeded to speak of

ENGINEERING IN HOLLAND AND ITALY.

It is frequently easier to lead water where it is wanted than to check its irruption into places where its presence is an evil, often a disaster. For centuries the existence of a large part of Holland has been dependent on the skill of man. How soon he began in that country to contest with the sea the possession of the land, we do not know; but early in the twelfth century dykes were constructed to keep back the ocean. As the prosperity of the country increased with the great extension of its commerce, and land became more valuable and necessary for an increasing population, very extensive works were undertaken. Land was reclaimed from the sea, canals were cut, and machines were designed for lifting water. To the practical knowledge acquired by the Dutch, whose method of carrying out hydraulic works is original and of native growth, much of the knowledge of the present day in embanking, and draining, and canal-making is due. The North Holland Canal (finished in 1825) was the largest navigable canal in existence until the Suez Canal was completed; and the Dutch have just now nearly finished making a sea canal from Amsterdam to the North Sea, which, though not equal to the Suez Canal in length, will be as great in width and depth, and involves perhaps larger and more important works of art. This country was for many years beholden to the Dutch for help in carrying out hydraulic works. In the seventeenth century much fen land in the eastern counties was drained by Dutch labour, directed by Dutch engineers, among whom Sir Cornelius Vermuyden, an old campaigner of the Thirty Years War, and a colonel of horse under Cromwell, is the most noted. While the Dutch were acquiring practical knowledge in dealing with water, and we in Britain, amongst others, were benefiting by their experience, the disastrous results which ensued from the inundations caused by the Italian rivers of the Alps gave a new importance to the science of hydraulics. Some of the greatest philosophers of the seventeenth century—among them Torricelli, a pupil of Galileo (Galileo, born 1564; Torricelli, born 1608)—were called upon to advise and superintend engineering works; nor did they confine themselves to the construction of preventive works, but thoroughly investigated the condition pertaining to fluids at rest or in motion, and gave to the world a valuable series of works on hydraulics and hydraulic engineering, which form the basis of our knowledge of these subjects at the present day. Some of the best scientific works (prior to the nineteenth century) on engineering subjects we owe to Italian and French writers. The writings of Belidor, an officer of artillery in France in the seventeenth century, who did not, however, confine himself to military subjects, drew attention to engineering questions. Not long after their appearance, the Ponts et Chaussées were established (1720), which has maintained ever since a body of able men specially educated for, and devoted to, the prosecution of industrial works.

Modern engineering in England, machinery for textile manufactures, steam navigation, the electric telegraph, railways, railway accidents, and State management, having come in for a large share of attention, the PRESIDENT proceeded to speak of

THE CONSUMPTION OF COAL.

A pressing subject of the present time is the economy of fuel. Members of the British Association have not neglected this momentous question. At the meeting held at Newcastle-on-Tyne in 1863, Sir William Armstrong sounded an alarm as to the proximate exhaustion of our coal-fields. Mr. Bramwell, when presiding over the mechanical section at Brighton, drew attention to the waste of fuel. Dr. Siemens, in an able lecture he delivered, by request of the association, to the operative classes at the meeting at Bradford, pointed out the waste of fuel in special branches of the iron trade, to which he has devoted so much attention. He showed on that occasion that, in the ordinary re-heating furnace, the coal consumed did not produce 1-20th part of its theoretical effect, and in melting steel in pots in the ordinary way, not more than 1-70th part; in melting 1 ton of steel in pots, about 2½ tons of coke being consumed. Dr. Siemens further stated that in his regenerative gas furnace 1 ton of steel was melted with 12 cwt. of small coal. Mr. Lowthian Bell, who combines chemical knowledge with the practical experience of an ironmaster, in his presidential address to the members of the Iron and Steel Institute in 1873, stated that, with the perfect mode of withdrawing and utilizing the gases and the improvement in the furnaces adopted in the Cleveland district, the present make of pig iron in Cleveland is produced with 3½ million tons of coal less than would have been needed 15 years ago, this being equivalent to a saving of 45 per cent. of the quantity formerly used. He shows by figures, with which he has favoured me, that the calorific power of the waste gases from the furnaces is sufficient for raising all the steam and heating all the air the furnaces require. It has already been stated that by working steam more expansively, either in double or single engines, the consumption of fuel in improved modern engines compared with older forms may be reduced to one-third. All these reductions fall far short of the theoretical effect of fuel which may be never reached. Mr. Lowthian Bell's figures go to show that, in the interior of the blast furnace, as improved in Cleveland, there is not much more to be done in reducing the consumption of fuel; but much has already been done, and could the reductions now attainable, and all the information already acquired be universally applied, the saving in fuel would be enormous. How many open blast furnaces still belch forth flame, and gas, and smoke as uselessly, and with nearly as much mischief to the surrounding neighbourhood, as the fires of Etna and Vesuvius? How many of the older and more extravagant forms of steam-engines still exist? What is to be done with the intractable householder, with the domestic hearth, where, without going to German stoves, but by using Galton's grates and other improvements, everything necessary, both for comfort and convenience, could be as well attained with a much smaller consumption of coal? If I have pointed out that we do not avail ourselves of more than a fractional part of the useful effects of fuel, it is not that I expect we shall all at once mend our ways in this respect. Many cases of waste arise from the existence of old and obsolete machines, of bad forms of furnaces, of wasteful grates, existing in most dwelling-houses; and these are not to be remedied at once, for not every one can afford, however desirable it might be, to cast away the old and adopt the new. In looking uneasily to the future supply and cost of fuel, it is, however, something to know what may be done, even

with the application of our present knowledge, and could we apply it universally to-day, all that is necessary for trade and comfort could probably be as well provided for by one-half the present consumption of fuel; and it behoves those who are beginning to build new mills, new furnaces, new steamboats, or new houses, to act as though the price of coal which obtained two years ago had been the normal and not the abnormal price.

Passing briefly over the question of artillery engineering, the PRESIDENT concluded his long and able address as follows:—Docks and harbours I have no time to mention, for it is time this long and, I fear, tedious address should close. "Whence and whither" is an aphorism which leads us away from present and plainer objects to those which are more distant and obscure; whether we look backwards or forwards, our vision is speedily arrested by an impenetrable veil. On the subjects I have chosen you will probably think I have travelled backwards far enough. I have dealt to some extent with the present. The retrospect, however, may be useful to show what great works were done in former ages. Some things are being better done than in those earlier times, but not all. In what we choose to call the ideal we do not surpass the ancients. Poets and painters and sculptors were as great in former times as now; so, probably, were the mathematicians. In what depends on the accumulation of experience, we ought to excel our forerunners. Engineering depends largely on experience; nevertheless, in future times, whenever difficulties shall arise, or works have to be accomplished for which there is no precedent, he who has to perform the duty may step forth from any of the walks of life, as engineers have not unfrequently hitherto done. The marvellous progress of the last two generations should make every one cautious of predicting the future. Of engineering works, however, it may be said that their practicability or impracticability is often determined by other elements than the inherent difficulty in the works themselves. Greater works than any yet achieved remain to be accomplished—not perhaps yet awhile. Society may not yet require them; the world could not at present afford to pay for them. The progress of engineering works, if we consider it, and the expenditure upon them, has already in our time been prodigious; 160,000 miles of railway alone, put into figures at £20,000 per mile, amounts to £3,200,000,000 sterling; add 400,000 miles of telegraph, at £100 per mile, and 100 millions more for sea canals, docks, harbours, water and sanitary works constructed in the same period, and we get the enormous sum of £3,340,000,000 sterling expended in one generation and a half, on what may undoubtedly be called useful works. The wealth of nations may be impaired by expenditure on luxuries and war; it cannot be diminished by expenditure on works like these. As to the future, we know we cannot create a force; we can, and no doubt shall, greatly improve the application of those with which we are acquainted. What are called inventions can do no more than this, yet how much is being done every day by new machines and instruments. The telescope extended our vision to distant worlds. The spectroscope has far outstripped that instrument, by extending our powers of analysis to regions as remote. Postal deliveries were, and are, great and able organizations, but what are they to the telegraph? Need we try to extend our vision into futurity farther? Our present knowledge, compared to what is unknown even in physics, is infinitesimal. We may never discover a new force—yet, who can tell?

On the following day, Thursday, Aug. 26, in the Economic Science and Statistical Section, a paper was read by Mr. W. STANLEY JEVONS, F.R.S., Professor of Political Economy, Owen's College, Manchester, on

THE PROGRESS OF THE COAL QUESTION.

The writer said his purpose was to compare statistical facts concerning the recent progress of the output of coal with various predictions and theories which had been published on the subject in the previous 15 years. The quantity of coal raised in the year 1873 amounted to the enormous weight of 127 million tons, according to the mineral statistics of Mr. Hunt. Professor Hull, in his valuable works on the English coal-fields, had questioned the power of the coal-fields to admit of a much greater drain in any one year than 100 millions of tons, at which rate, he believed, the supply would be sufficient for eight centuries. Facts now entirely negatived this hypothesis. Sir William Armstrong, in his presidential address at the meeting of 1863, put forward his celebrated calculation that the produce of coal was advancing by a uniform arithmetical progression of 2¾ millions of tons yearly, at which rate our coal, as then estimated, would last only 212 years. According to this law of increase, the produce in 1873 ought to be 119 millions, which, however, was 8 millions less than the truth, the increase in the interval being no less than 41 millions, instead of 33 millions, according to Sir W. Armstrong's method of calculation. The average annual addition to the output is now nearly 3½ millions of tons, instead of 2¾, but the true law could not really be that of arithmetical increase—which, if followed backward, would lead us to zero about the year 1830—but was that of a geometrical series with the average annual ratio of 3½ per cent. According to this law, it was calculated that the produce of coal in 1871 would be about 1179 million tons. According to Mr. Hunt's statistics it proved to be actually 117,352,028 tons. On the same method of calculation, the produce of 1873 would be about 1263 millions, and the actual quantity raised exceeded this by about 700,000 tons. Mr. Price Williams believed that the rate of increase of consumption of coal per head had passed its maximum and was declining, whereas the most recent statistics showed that between 1869 and 1873 the advance was more than double that in the interval between 1865 and 1869. In the year 1872 the price of coal rose in many places to a height two or three times its previous highest amount. This rise was in some respects exceptional, but was mainly due to the increased demand which, in spite of the enormous price, advanced 5 per cent. per annum. The great increase in the number of collieries produced by the extraordinary demand would, no doubt, render the price more moderate for some time, but the coal famine of the years 1872-3 might be regarded as the first twinge of the scarcity which must come, and it had taught us that coal had now become the first necessary of life in this kingdom.

In the discussion that followed,

Mr. SOPWITH thought that great advantages would result from the efforts of social science to direct attention to that particular subject, and to give opportunities of knowing and carrying out the most approved plans for economy. Whatever might be the duration of the coal supply, he was quite sure that the prospect of very considerably increased price justified every means taken in promoting economy.

Mr. FELLOWS said the increased price of coal, so far as the English coal was concerned, might cause coal to be imported into England, from which time our manufactures would assuredly decline.

Mr. BENNOCK said the waste of coal that was going on was a matter of everlasting disgrace to the genius of our country, and to the scientific knowledge that prevailed in large towns. They had only to enter Leeds, Manchester, or Bristol to witness the smoke hanging over the city, showing the waste of coal which ought to be hoarded for future occasions.

The discussion was continued by Dr. FARR, Professor TENNANT, Professor LEONE LEVI, &c.

Professor JEVONS, in reply to a question, stated that the consumption of coal in household use was from 30 to 40 million tons a year—about a fourth of the total quantity consumed. In reply to Sir James Alexander, he said he thought the prohibition of the export of coal would do harm.

In the chemical section, the PRESIDENT (Mr. A. Vernon Harcourt) read a paper on his apparatus for estimating carbon bisulphide in coal gas, which has recently been described in this JOURNAL.

On Monday, the 30th ult., in the Department of Anatomy and Physiology, Mr. W. J. COOPER read the following paper on

SOME PHYSIOLOGICAL EFFECTS OF VARIOUS DRINKING WATERS.

In 1870-73, M. Würtz, the Dean of the Ecole de Médecine, in Paris, presented to the French Academy of Sciences two important papers by M. F. Papillon. In those papers it was shown that the phosphate of lime in bone is capable of being replaced to a considerable extent by the phosphates of strontia, alumina, and magnesia. The first experiments of M. Papillon were commenced on Monday, Sept. 6, 1869. He took a young pigeon, shut it up in a cage, and fed it with wheat rolled into a fine paste, and mixed with some phosphate of strontia and a solution of chlorides, carbonates, sulphates, and nitrates of potash in the proportion of 1½ grammes to the litre of distilled water. A small quantity of hydrochloric acid was also added. On the 1st of April, 1870, the pigeon was killed. An analysis of the bone ash showed—

Lime	46·75
Strontia	8·45
Phosphoric acid	41·80
Phosphate of magnesia	1·80
Residue	1·10
	99·90

Another pigeon on the same date as the preceding was supplied daily with a solution of phosphate and carbonate of magnesia, and distilled water. Killed on the 4th of April. The analysis of bone ash showed—

Lime	51·76
Magnesia	1·81

On Sept. 16, 1869, a white rat, six days old, was treated daily with a decigramme of phosphate of alumina in a litre of distilled water, with rice and gluten. On Nov. 29, 1869, the rat died suddenly of convulsions. A post mortem examination showed inflammation of the intestines, attributed to the mechanical effect of nodules of phosphate of alumina. The rat was boiled in distilled water, and then boned. The bone ash contained—

Lime	41·10
Alumina	6·95

On the same date as the first rat, a little rat of the same litter was put under the same conditions, except that in place of phosphate of alumina, phosphate of magnesia was administered. This rat was killed on Nov. 25, 1869, apparently quite healthy. The bone ash was found to contain—

Lime	46·15
Magnesia	3·56

May 21.—Six chickens, just hatched, were taken; one killed immediately; others fed with rice, cooked in distilled water, with phosphate and carbonate of magnesia added to the ordinary salts in the water they drank.

June 28.—Rice replaced by wheat, cooked as the rice.

The five chickens were killed at different periods.

	Ash showed in Analysis—	
1. July 4, 24 days old	Lime	53·45
	Magnesia	0·83
2. July 12, 31 days old	Lime	51·59
	Magnesia	0·90
Three others, 41 days old	Lime	50·51
	Magnesia	2·01

There were only inappreciable traces of magnesia in the bones of the chicken killed at the moment of its birth. The bones of all these animals had preserved their ordinary aspect and physiological properties, and there was no disturbance of the normal functions of the system. Bone ash, as is known, consists of phosphate of lime, with about 2 per cent. of phosphate of magnesia, and more or less carbonate of lime. The full importance of these experiments does not seem to have been fully appreciated. It is not only shown that the ash of the food which is eaten affects the composition of the bones, but that mineral matter in dilute solution is capable of being assimilated. The experiments are, in fact, experiments on different kinds of artificial drinking waters, and illustrate how profoundly the bodies of animals are influenced by the mineral constituents of the water which they drink. They seem to show that the effect of altering the composition of the water supply of a community might involve questions of vast importance to the organic structure of the human body, if the very composition of our bones is affected by the quality of the water. If the water contains lime, lime may be taken up and would appear as phosphate of lime in the bones; if strontia, as phosphate of strontia; if magnesia, as phosphate of magnesia. If by any combination of circumstances these salts should be deficient, the bones would be imperfectly supplied with mineral matter. It is said that such instances have occurred in Holland in districts where the inhabitants can only obtain rain water for drinking purposes. This fact, probably combined with an absence of lime in their food, occasions a softening and distortion of the bones of the body. By varying a water supply it might be possible to alter the physical organization of a population, and in future ages, from the examination of the bones of bygone generations, the character of the water they were in the habit of drinking might possibly be deduced. So much attention is now directed to organic impurity in drinking water (a defect which can be completely remedied by careful filtration) that the inorganic impurities have been almost overlooked, although there are numerous instances where serious consequences have arisen from the incautious use of deep spring waters. Some time ago, at Hendon, in Middlesex, an artesian well was bored to supply the water necessary for some valuable horses which were being reared there. The water was bright looking, pleasant to the taste, and quite free from any organic impurity; the foals, however, who drank the water soon died, and the whole stud were seriously affected with diarrhœa. Professor Way, one of the Royal Commissioners on Water Supply, analyzed the water, and it was found to contain sulphates of magnesia and soda in considerable quantity. On discontinuing the use of the water the disease was arrested. A similar case occurred at Rugby, but human beings were the sufferers. The water from an artesian well free from organic impurity was hailed with satisfaction at its brightness; the community, however, were attacked with diarrhœa caused by the sulphate of magnesia or Epsom salts present in the water, and the supply had to be discontinued, as there is no known method of freeing the water from sulphates. The opinions of some leading authorities on water supply have undergone considerable modification recently. A few years ago Dr. Frankland returned all solid matters in water as impurities in the analyses he made. I was, therefore, much surprised to hear him recommend as a supply to a district, containing 14,000 inhabitants, a water proved by analysis to contain 12½ grains of anhydrous sulphate of magnesia per gallon, equal to 25 grains per gallon of Epsom salts. This evidence was given last session before a committee of the House of Commons. Dr. Frankland stated that it was absurd to say that a water containing such a quantity of Epsom salts could be objectionable from a dietetic point of view. Fortunately for the health of the people, the parliamentary committee refused to allow the district to be supplied with the Epsom salt solution. The water of St. Ann's Well, at Buxton, the slight purgative quality of which is considered as one of its merits, contains an amount of magnesia equal to 13 grains of Epsom salts per gallon. It is known that goître and other throat and glandular affections, and even idiocy, have been attributed to inorganic salts in drinking water. We know that the human system is easily deranged by a change in the drinking water. The spa and chalybeate waters at the favourite places of resort have been renowned for ages for their medicinal virtues. If the entire organic structures of the human body

are liable to alteration when excess of mineral matter is introduced into the system, it is essential that health-seekers at these medicinal springs should place themselves under medical supervision. And one of the first considerations in the inauguration of a water supply should be to ensure a perfect freedom from excess of any minerals except those comparatively harmless ingredients—chloride of sodium and carbonate of lime.

Dr. CORNISH, of Madras, who made some remarks on the paper, said that he had found that persons in India who drank water from wells sunk in districts where there were large tracts of limestone suffered from peculiar diseases.

Dr. CHILD having expressed the great obligation he was under to Mr. Cooper for his admirable paper, said he dared say many gentlemen there would remember that some few years ago, during the proceedings of the British Association, Professor Tyndall gave some lectures at the Royal Institution, London, and a long abstract of them appeared in *The Times*, which excited considerable remark. He (Professor Tyndall) said anything not chemically necessary to the constitution of water was impurity. This might be chemically correct; but it was not clear to his mind that chemically pure water could be obtained—certainly it could not from any natural source—and he thought that such water would not do them any good if they could get such a thing. Now that there was so much sanitary legislation, the results given by Mr. Cooper were of the gravest importance. He was afraid that not sufficient attention was paid to inorganic impurities in water. Public health officers and others did not go further than the organic impurity unless their attention was called to some special case.

Mr. COOPER, in replying to the observations made, reminded his hearers that he had specially excepted chloride of sodium and carbonate of lime.

In the Physical Science Department, Mr. JAMES GLAISHER presented the report of the Rainfall Committee. It began by giving an epitome of the rainfall work done in connexion with the British Association during the last 14 years. It then referred to the steps taken after the meeting at Belfast to obtain additional stations in Ireland, which were so successful that the committee received 190 offers of assistance. The acceptance of all these offers would have involved an expenditure far beyond the funds at the disposal of the committee, and they were, therefore, reluctantly compelled to make a careful selection, resulting, however, in the establishment of 66 stations, many of them in localities of extreme importance. After referring to various other work in hand, the committee said: "Looking back over the past 15 years, there would be found among the work accomplished the following items:—The number of stations had been raised from 241 to nearly 2000; the influence of size and shape on the indications of rain-gauges had been experimentally examined, and also the effect of height above ground; the laws which regulate the seasonable distribution of rainfall had been ascertained; the secular variations of annual fall had been approximately determined; a code of rules had been drawn up for observers: nearly 250 stations had been started at the cost of the association, and 629 stations had been visited, and the gauges examined by the secretary. They had obtained and supported observations on mountain tops and other inaccessible places where no observations had been made in Cumberland, Westmoreland, Wales, and Scotland, and also an extensive series in Ireland. When the works actually in hand were completed, they would also have furnished an index to all observations hitherto made, and a guide to the value to be attached to the returns from, at least, a thousand. Irrespective, however, of any future work, they had had the satisfaction of assisting to make the rainfall system of the British Isles the most nearly perfect in the world.

The CHAIRMAN (Professor Balfour Stewart) said it would be a great pity if all this machinery should now be given up. It ought rather to be supplemented by a more liberal grant of money from the association.

Professor JEVONS thought if the association could not continue its grant, Government ought to provide a few hundreds a year for the acquirement of such very important facts. How much was the grant of the association?

Mr. SYMONDS: About £100 a year.

Professor JEVONS inquired if any steps had been taken to have the grant renewed.

The CHAIRMAN replied in the affirmative, but was unable to state with what result.

Several other gentlemen expressed great dissatisfaction at the prospect of the observations on rainfall being discontinued.

On Tuesday, the 31st of August, in the Mechanical Science Department, Professor HULL read a paper on

WATER SUPPLY TO VILLAGES OF THE CENTRAL AND EASTERN COUNTIES.

After referring to the prevalence of zymotic diseases in villages, hamlets, and country parishes, admittedly due to "dirt" (which, as Lord Palmerston defined it, is "matter in the wrong place") and bad water, the author said he proposed to deal with the latter evil by a scheme applicable to the central and eastern counties of England. This scheme was only intended to apply to those districts which came under the division of "rural sanitary districts" of the Public Health Act of 1872, the "urban sanitary districts" being provided for by local resources and engineering skill. But the author maintained that, in a large number of instances, the villages and hamlets required the introduction of some system of water supply quite as much as the larger towns and cities. His proposal involved a double system of supply, applicable to two different sets of cases—(1) either by means of wells; or (2), where wells were inadmissible, by surface streams. He proposed, as a preliminary step, that, by the aid of the rural sanitary officers appointed under the Act of 1872, returns should be obtained regarding the water supply at present in existence in the villages and hamlets throughout the central and eastern counties. These returns were to be transmitted to the Central Board of Health in London, and from them it could be determined what were the cases requiring the application of a scheme of supply. He then proceeded to point out how favourably circumstanced were those districts of England to which his observations applied for a system of supply, by means of wells of greater or less depth. From the knowledge now possessed on such subjects, it was certain that by means of wells or borings supplies of water could be obtained, not only in localities situated on water-bearing strata, but in those situated on the overlying impermeable strata, according to depth. At the same time, there would necessarily be a large number of villages and hamlets where the depth to the water-bearing beds, and the cost of reaching them, would be too great for the resources of the inhabitants. These would have to be dealt with by other means of supply. In order to carry out a general scheme applicable to all villages found, from the returns of the medical officers of health, to be insufficiently or improperly supplied, the author proposed to utilize the maps of the Government Geological Survey, now nearly complete, for the districts referred to, and on which the areas of the water-bearing and impermeable formations respectively are accurately laid down. With the aid of these maps (which were easily obtainable) it could be determined by the local sanitary authority whether any special village or hamlet was so situated as to be capable of receiving a supply by a well of reasonable depth. In case of necessity, however, professional advice might be called in, but the author considered that, owing to the special nature of such cases, it would be necessary to have a geologist of experience attached to the central Board of Health, whose duty it would be to advise with each local sanitary board as occasion might arise; this officer should also assist in the selection of a proper site for a well, and afford data for determining the depth and cost of sinkings, &c. Upon the report by the officer of the Local Board of Health, certified by the Government adviser, of the feasibility of a plan of water supply by a well or bore-hole, an order should issue for the compulsory carrying out of the work, and power should be vested in the local sanitary authority to raise money for the purpose. The well thus constructed should be carefully preserved from pollution, and be accessible to the inhabitants of the village or hamlet comprised in the order. At the same time all objectionable or impure sources of supply should be destroyed or stopped up. In cases, on the other hand, where it is found that, owing to the position of any village or hamlet in reference to the sub acent water-bearing formation, the depth and cost would be too great for the resources of the inhabitants, then it would be necessary to have recourse to the most suitable stream or brook, which should be put under strict regulation as regards the prevention of contamination. The author proposed that in such cases small tanks should be constructed for storeage of the waters in the winter, and should be vested in the local sanitary board, who should be responsible for their due preservation. In conclusion, the author expressed his opinion that the time for carrying out some general scheme of water supply for the greatly neglected villages and country parishes had come, and which he considered might be carried out by combining the information to be derived from the Geological Survey maps with the powers granted under the Public Health Act of 1872. He considered that any scheme to be of use should be both compulsory and of general application. Until every village and hamlet, as well as every town and city, had a constant supply of pure water for domestic purposes, sanitary legislation could not be considered to have effected its purpose.

Captain GALTON said he thought villagers would not be able to bear the increased rates that would be required to carry out Professor Hull's system, and he thought landowners would object to lay out a large sum of money for the purpose. He feared they would not be able to carry out the arrangement in any large part of the country. He thought they would have to rely on wells attached to two or three cottages.

Mr. DEACON said there was no difficulty in finding water; but the difficulty was in storing.

Mr. DINES thought more attention should be paid to rain water for the supply. He believed they might collect quite sufficient for the purpose of the household from every cottage.

A MEMBER said he had a house at the seaside that he resided in four months of the year, and for the last 15 years he had had no other supply. The water was perfectly pure, bright, and cool.

Professor HULL, in reply, said the money difficulty ought not to be insuperable, for the money might be obtained in various ways for such a purpose. He believed that ultimately they would have to come to a compulsory plan for giving fresh water to country parishes. Any one who lived in the country knew how bad the supply was, and the amount of sickness and misery engendered in consequence.

The CHAIRMAN said wherever he went he saw as great a waste of water in their towns as he did of the coal supply in their manufactories and steamboats. Not only that, but there was a continuous and steady contamination of the sources of supply going on. He had no doubt that ultimately they would have to depend upon the rainfall. Wherever he went he saw land and commons, on which the rain used to fall and give a pure supply, heavily laden with filthy manure, through which it was impossible that clean water could pass. He regretted that the subject was not taken up as a national one. He was surprised that the people of England were not sufficiently frightened to maintain anything like a water supply uncontaminated by poisonous sources. He was sure the section was exceedingly obliged to Professor Hull for his paper.

A paper was read by Mr. ASHMEAD, C.E., on

THE SEWERAGE OF BRISTOL.

The writer having at some length described the character of the district drained, and the nature of the works already effected, said it would be seen that at present no determination had been arrived at with regard to the ultimate disposal of the sewage of the borough, which was still discharged into the tidal river at five separate outlets. The total cost of the drainage works to the present time had been £154,743, which, taking the estimated population of the borough at 196,186, gave as the cost per head 15s. 9½d. This amount had been raised by rates in each separate district, varying from 1s. 6d. to 2d. in the pound. The whole cost in the two first-named districts having been repaid, the special rate had ceased; in the next two districts it would expire in 1878, in the fifth district in 1880, and in the last district, the amount borrowed having been spread over 30 years instead of 20 years, as in the other districts, the repayment would extend to 1901. The average death-rate before the construction of the foregoing works was 28 per 1000, and for the year ending January, 1875, it was 22·7.

Mr. THOMAS HUDSON, F.S.S. (for Mr. Henry Masters), read a paper on

A SEWAGE-GAS TRAP.

The author said that two facts had come under his notice, and he believed they were generally admitted. The first was that gases existed in the public sewers, and such gases were affected materially by atmospheric and other changes; the second, that, under certain conditions, these gases occasionally found their way into our dwellings, and thereby spread disease. The object of the paper was not to lay down a scheme for the ventilation of the public sewers, or for the ventilation of the drain-pipes inside dwellings, but to suggest a simple and efficient remedy by which sewer gases, when they arose, might be prevented from passing into our dwellings by the ordinary drain-pipe; and the desirability of some arrangement being insisted upon by our sanitary authorities in all buildings. He had prepared a rough sketch, showing an arrangement which, in practice, he had adopted during many years, and found always effective. This, although providing for the exit of gas when the necessity arose, was not, as in the common mode of ventilating pipes, always in action, and the pipe, in relation to the drain, was unusually large. The gases, if they were forced through the first trap, met with a resistance when they reached the second trap, and escaped readily up the large air-pipe, which, of course, should be carried above the highest point of the building, and not too near the tops of chimneys.

In the Chemical Section, Professor CORFIELD, M.D., presented the report of the Sewage Committee. He said the report this year was short, as the experiments were very incomplete, owing to the want of funds for the purpose of analysis, and paying servants to observe, and so on; but he dared say a great many of them knew a gentleman of that section had supplied them with funds, and would continue to do so indefinitely, so that next year they would be able to give a much more detailed report, and upon a larger number of observations. However, some results had been obtained this year which were of considerable importance, and which showed to a very great extent the accuracy of the methods adopted, although this year methods had been carried out so imperfectly. The report dealt, in its first part, with the sewage farm near Romford. During the past year the total weight of crops grown on the farm was 200 tons less than in the previous year. The reasons for this were that the kind of crops grown was different; a large amount of land was allowed to lie fallow, and a certain quantity of crops ploughed in and not carried off the land. When they came to take the number of acres of land planted during the past year, and to examine them in connexion with the weight of crops grown and the weight of nitrogen in these crops, they found that the weight of produce per acre had been progressively increasing during the last three years; but last year the weight of produce per acre was considerably more than the year

before, while the weight in the year before was greater than in the year before that. In the year 1872-73 the weight of produce grown was 10 tons per acre planted; in 1873-74, 13·8 tons; in 1874-75, 16·5 tons. The same result was seen in the amount of nitrogen recovered in the crops, as in the first year there were 101 lbs., in the second year 133 lbs., in the third year 153 lbs.; so that, although the total amount of crops produced had been less, when they came to consider the amount of land on which they had been produced, the total amount of crops and nitrogen was more. The result was due to two causes—first, the concentration of sewage on fewer acres; and next, to the increasing richness of the soil, a fact which had already been demonstrated by the committee in their fifth report. The year 1871-72 formed an apparent exception. The amount of crop then grown was greater than had ever been known on the farm—that is to say, it was never equalled since. But it was only an apparent exception. Then there were no cereals grown on the farm; there had been much more grass and mangolds, and so on. The amount of produce per acre then was less than the year they were now reporting on. The results of analyses between April, 1874, and March, 1875, showed that the total nitrogen of the sewage was very near to the average results already obtained; thus in the year 1871-72 the average was 5·529, and in 1872-73 it was 5·151 per 100,000. The total amount of nitrogen recovered in the crops was estimated at 20,166 lbs., or 31·8 per cent. of the nitrogen supplied, being exactly the mean of the amounts for the two last years. The amount of nitrogen lost in the effluent water could not be ascertained, as the amount of the effluent water was not known.

Mr. J. C. Mellis read a paper on

THE TREATMENT OF SEWAGE.

Although it is to be regretted that another year has passed without further and much-to-be desired legislation upon sanitary matters, it is not difficult to see reasons for the inability of Government to deal off-hand with the subject which, in the form of a Rivers Pollution Bill, Lord Salisbury so ably introduced to the House of Lords during the past session. The Government is scarcely yet in a position to define the extent to which pollution of rivers is to be prevented, or even what the term pollution really includes. These points will doubtless, together with a definition of the term "best known practicable means for purification of town sewage and manufacturing refuse," occupy the attention of the Local Goverment Board before the reassembling of Parliament for the transaction of public business. But until the Government takes the rivers under its own supervision, and lays down some clear guiding rules on these points, we shall not, I think, see much practical sanitary reform in this direction. The purification of our rivers is, however, in fact, a much simpler matter than is generally supposed. Their pollution is caused chiefly by town sewage and manufacturing refuse, and both of these can now be purified at a cost that would neither ruin nor even press heavily upon ratepayers or manufacturers. But the subject requires to be taken in hand in an earnest, vigorous manner, very different from the dilatory spirit which has, to a great extent, characterized it during the past. Liebig's words are eminently applicable to the treatment of sewage when he says: "Whenever success does not attend a good cause, the fault lies in want of energy in using the proper means, for these are always to be found." There are various means already known for the purification of sewage and manufacturing refuse, each of them possessing some merit, but also much that is impracticable. My present purpose is, however, to give a brief account of the means by which, during the past sixteen months a daily flow of 2 million gallons of polluted liquid, being the whole sewage and manufacturing refuse from one of our large manufacturing towns, has been completely purified, and a river, one of the tributaries of the Avon, which formerly received it, also so completely purified as to satisfy all parties concerned in the neighbourhood. Not only in a sanitary point of view is the purification of this river approved of, but a return of its fishes to its waters testifies to the value of the work which has been accomplished. I refer to the town of Coventry, the population of which is 40,000, and where, amongst other manufactories, there are some eight or ten dye-works. The sewage and refuse from the whole amount to 2 million gallons in 24 hours, and, in consequence of the refuse dye, it is of an exceptionally foul character, and far more polluting than ordinary town sewage where no manufacturing refuse exists, and on this account also more difficult to purify. The corporation of Coventry tried various schemes to enable it to comply with an order by the Court of Chancery to discontinue the pollution of the river Sherburne; but all of them failed in a more or less degree to accomplish the desired object. After these various trials and failures, works for chemical treatment of this sewage and manufacturing refuse by means of sulphate of alumina and lime were commenced by the General Sewage Company about two years ago, and completed in the month of April last year. Since then, when the works were opened for the first time, they have been in constant operation, and exhibit in a most satisfactory manner that the work of purifying our rivers can, without doubt, be accomplished at a moderate cost. The sewage and manufacturing refuse, mixed together, to the amount of two million gallons daily, is received at the works as it flows from the town in a continuous stream. It is first mechanically strained, so that the largest solid matters in suspension are removed and deposited in one place. This operation is performed entirely by machinery, and does not cause the slightest nuisance. The matter thus extracted is found to contain, in addition to fœcal matter, garbage of all sorts, and dead rats, some rather remarkable constituent parts, amongst which have been seen living fish. A pike about 12 inches in length on one occasion made his appearance, and being none the worse for his perilous circuit of "Latham's Solid Sewage Extractor," was well cared for by the man in charge; he was eventually placed in the purified water of the Sherburne, where he scuttled away, apparently delighted with the episode. Living frogs, silver-mounted meerschaum pipes and walking-sticks, and, very rarely, spoons and forks are also amongst the curiosities of "Extracted Sewage." Such articles are, of course, removed, and the residue, when dried, is used as an agricultural manure. The sewage, thus strained and freed from its grosser contents, and therefore in a better condition for chemical treatment, then passes through a block of buildings where it receives continuously a charge of sulphate of alumina in solution, and is thoroughly mixed therewith. These buildings are well provided with steam-engines, boilers, and mixers, as well as ample machinery of a first-class character, adapted not only for the admixture of the chemicals with the sewage, but also for the manufacture of the chemicals employed. The sewage next passes on to a second block of buildings, and therein receives a charge of milk of lime, and is thoroughly mixed therewith by means of machinery. Indeed, everything that can be is accomplished by the aid of machinery, and the small number of men on the works is one of the remarkable features of the place. The sewage thus chemically treated is then allowed to flow on in a continuous stream to the precipitating tanks. These, when full, are so arranged as to allow the effluent water, in a thin clear sheet, to pour over weirs at the extreme end of the tanks. This water is then in a sufficient state of purity to enter most rivers, or the sea. It is, however, in this condition, subjected to a process of filtration, and for that purpose is conveyed to a filter-bed properly drained and prepared. It has been found that a comparatively small quantity of land—four acres and a half—would suffice to filter the effluent water from the sewage of Coventry. Nine acres have, however, been prepared, for the purpose of always having another filter-bed ready when the one last in use requires rest or repair. The effluent water, as it passes into the river Sherburne from the three large mains of the filter, at the rate of about 80,000 gallons per hour, is clear and bright, and not only so, but of a high standard of purity, as is shown by the following analysis of it made by Dr. Voelcker:—

An Imperial gallon contains—

	Grs.
Organic and volatile matter (including ·672 of oxidizable organic matter)	1·27
Oxide of iron and alumina	0·28
Phosphoric acid	0·13
Sulphate of lime	16·98
Carbonate of lime	9·20
Nitrate of lime	1·35
Nitrate of magnesia	1·85
Chloride of sodium	7·44
Carbonate of soda	1·07
Carbonate of potash	5·23
Soluble silica	0·42
Total solid constituents (dried at 130° C.)	45·22
Free (saline) ammonia	0·630 of a grain.
Organic (albuminoid) ammonia	0·042 „ „

Dr. Voelcker further says:—"The water has no perceptible smell, and is almost free from colour; it contains but little organic (albuminoid) ammonia, and not much more than half a grain of saline ammonia per gallon." And, further, that the nitrogenous organic constituents of raw sewage appear to have become oxidized and changed into nitrates to a very large extent. The sewage of Coventry, at noon, has been found to contain as much as 5·85 parts of ammonia in 100,000 parts. Having thus succeeded in purifying this enormous volume of liquid, and produced an effluent water of a standard of purity such as to support life, the reduction of the solid precipitated matter, or "sludge," as it is called, into a portable form, is none the less important; otherwise, the measures employed for the purification of a river would only result in the accumulation of enormous quantities of semi-fluid matter, which would cause as great a nuisance on the land as it would if cast into the river. The amount of "sludge," containing 80 per cent. of water, precipitated from two million gallons at Coventry, is about 20 tons per day. It is this very large quantity of "sludge" that, by clogging and choking the pores of a filter on the ground, would render the filtration of crude sewage on a large scale impracticable, and form one of the various objections to sewage farming. It is necessary, therefore, in order that the purification of sewage and manufacturing refuse by chemical precipitation should be successful in a sanitary point point of view, that this "sludge" should, each day as it is produced, be converted into a portable condition by depriving it of its water. At the Coventry works, this is accomplished by means of atmospheric filters, the sludge being afterwards completely dried, either by passing it through Messrs. Milburn's drying machines, or by absorption of the moisture contained in it through admixture with chemicals, which, at the same time that they form a drying medium, also add a fertilizing agent to the manure so produced. The analytical composition of unfortified dry sewage manure, as produced at Coventry, is shown by Dr. Voelcker's examination of it to be as follows:—

Moisture	7·43
*Organic matter and water of combination	26·45
Phosphate of lime	3·75
Sulphate of lime	1·93
Carbonate of lime	11·46
Oxide of iron	3·75
Alumina	7·98
Alkaline salts and magnesia	2·75
Insoluble silicious matter	34·50
	100·00
*Containing nitrogen	1·38
Equal to ammonia	1·67

A manure of such a composition as the foregoing, as compared with Peruvian guano, is worth 35s. per ton; but, by the fortifying and drying processes which are now in use at Coventry, its value is raised to any amount desired. What, therefore, has been done at Coventry can be done elsewhere; and, although the purification of sewage and manufacturing refuse cannot be carried out without a certain charge upon ratepayers and consumers of manufactured goods, that charge need be but a moderate one. Manufacturing refuse will have to be either cast into the sewers, as is the case at Coventry, or dealt with separately, according to arrangement. The latter will, I believe, be the plan most generally adopted in the end, where practicable, because manufacturers will begin to find that what is now, in many instances, cast away as useless will some day be turned to account. The process in use at Coventry requires chemicals to the value of £2 12s. 10d. for the purification of one million gallons, and these chemicals are easily obtainable in any quantities in this country. The process is applicable, also (and has been experimentally tried with success), to other manufacturing refuse, including that from paper-mills, fellmongers, and tanneries. The one great object in view, in carrying out these works at Coventry, has been to achieve a sanitary success at a moderate cost, irrespective of party feeling or short-sighted policy. The following extract from a recent number of *The Times* tells to what extent that has been accomplished:—"The question of national importance, however, is not so much how to turn town sewage to profitable account, as how to prevent it from being injurious to health. The latter is an affair of necessity; the former is very desirable, but it cannot be put in the first rank. There can be no doubt that the works at Coventry, whatever may be the ultimate commercial value of their products, deal with the sewage nuisance in a perfectly satisfactory manner. The works themselves are models of order and good arrangement. The mechanical contrivances for the various processes are exceedingly ingenious. The operations, from first to last, are entirely odourless and inoffensive, and the effluent water would be drunk without question by anybody who was not aware of its source. In all these respects the example set by Coventry cannot be too closely followed elsewhere."

On Wednesday, Sept. 1, in the Geological Section, Mr. C. E. De Rance, F.G.S., read the following report on

THE UNDERGROUND WATERS IN THE NEW RED SANDSTONE AND PERMIAN FORMATIONS IN ENGLAND.

The committeee appointed last year, with Professor Hull, F.R.S., as chairman, and your reporter as secretary, for the purpose of investigating the underground waters in the New Red Sandstone and Permian formations of England, and the quality and character of the water supplied to various towns and districts from these formations, have largely circulated a form of inquiry to elicit the information necessary to carry out the investigation with which the association has entrusted them. Special knowledge and local influence being required in each particular area, your reporter obtained the consent of the following members of your committee to undertake the charge of districts:—In the north-west of England, Professor Harkness, F.R.S., Messrs. Binney, F.R.S., Morton, Millard Reade, and your reporter. In the north-east, Professor Green and Messrs. Howell and Fox-Strangways. In the Midland counties, Messrs. Plant, Molyneux, Tylden-Wright, and the Rev. H. W. Crosskey. In the south-west of England, Messrs. Pengelly, C. Moore, and the Rev. W. S. Symonds. Valuable returns have already been made by Messrs. Plant, Moore, Millard Reade, Pengelly, and Tylden-Wright. Your committee regret to report that, through the action of certain corporations and companies seeking additional parliamentary powers, and from other causes, information has been withheld from the committee, and that firms and indivi-

duals in some towns have also refused to communicate the results of wells and well-borings made by them. But your committee venture to hope these difficulties may be overcome, and take this opportunity of thanking Professor Ramsay, F.R.S., the Director-General of the Geological Survey of the United Kingdom, for giving instructions to the officers of the survey to place any information they may have in the hands of your committee. Sections they obtained from Mr. Clifton are incorporated in the report now submitted to you, and mainly consist of long lists of strata passed through in the sinking of various wells, and analyses of the waters obtained. I propose only to briefly allude to some of the more important results obtained. First, as regards quantity, in the Nottingham district the Bestwood pumping station yields more than 3½ million gallons per day from the pebble beds, the supply of water from which, as proved by colliery operations in the Newstead area, is practically inexhaustible. The Wall-grange springs, near Leek, in Staffordshire, in the same formation, supplying the Potteries water-works, also yield 3 million gallons daily; and in Liverpool and in Manchester the New Red Sandstone yields more than 6 million gallons per day to the various wells of those districts. Plentiful supplies are yielded by wells in the south-west of England, reported on by Messrs. Pengelly and Moore, at Maidencombe, near Torquay; Teignmouth, Tiverton, Dawlish, Bramford, Speke, near Exeter; Taunton, Wellington, and Wembdon. In the Midland counties, at Leicester, Nuneaton (250,000 gallons), Coventry (well entirely in the Permian, yielding 350 gallons per minute), Hinckley, Elmsthorpe, and Hathern, where the water rose 50 feet into the air from the Lower Keuper Sandstone. In the water obtained from a well at Whitmore, near Crewe, the site of which was chosen by Professor Hull, only 6·10 grains of solid matter occur, and in another of the London and North-Western Railway wells, that of Parkside, near Warrington, only 11·12 grains of solid matter per gallon occur, the degree of hardness being 4·1 after boiling. The water is stated by Mr. Ramsbottom, the superintendent of the locomotive department of that railway, to be the best for engine boilers of all the waters obtained on the company's system. Good supplies of moderately hard water, are supplied by New Red wells, to Southport, Birkenhead, Ormskirk, St. Helen's, Ince, and a large number of other towns in Lancashire. The available area in England of water-bearing New Red and Permian formations is much larger than the actual outcrop of these works as shown on the geological maps, there being extensive tracts of Lias and other newer formations that can be easily penetrated, and a supply of water obtained, as at Scarle, in Lincolnshire, where a bore-hole of four inches penetrated the Lias and Keuper Marls, and struck in the lower Keuper Sandstone a feeder of water, which rose to the surface and yielded eleven gallons. Below this feeder, which occurred at 790 feet, another was struck at 950, which yielded a much larger supply. Second, as regards quality. The various analyses obtained place the New Red and Permian waters in an intermediate position between the hard waters of the mountain limestone and chalk and the soft waters of the Palæozoic rocks. Mr. Plant reports the Permian water of Leicestershire as soft, the water from the Bunter New Red beds as nearly soft, and those from the Keuper Sandstone as hard, containing carbonate and sulphate of lime; it is the presence of the last ingredient in the water used in brewing at Burton-on-Trent, by Messrs. Bass, Allsopp, Salt, and other firms, which is believed to give the Burton water its special pre-eminence in the manufacture of beer. Mr. Molyneux believes the large amount of calcareous ingredients here met with (70 grains in an imperial gallon) to be due to the water dissolving all the gypsum of the Keuper Marls of Needwood Forest, from whence it flows down the dip planes of the strata to the Burton Valley fault, up which it rises, and is tapped by the artesian boring of the breweries. Some of the wells close to the Mersey show examples of very hard water, and are daily becoming more so, through the percolation of salt water, induced by pumping inland, but this in no way affects the large wells used by the corporation for water supply further from the river. Next year, your committee hope to report on—1. The water-bearing properties of the whole of the English New Red and Permian formations; 2. The nature and chemical character of the waters obtained; and 3. The effect of these waters on the sanitary condition of the people using them. And they cannot but hope that, looking to the almost absolute freedom from organic impurity in water from wells, properly constructed in their formations, they may, by pointing out suitable sites for wells in areas at present without them, be the means in many districts of improving the health and lessening the death-rate of the population.

The PRESIDENT (Dr. T. Wright), speaking as an officer of health, said this question of water supply was becoming the question of the day, and unless science could render aid they would be very much at a loss in the rural districts. Probably by this time next year the bill would have passed against pollution of rivers. Then would come the question of the utilization of town refuse.

Professor HULL remarked that scarcely any country possessed such natural facilities for obtaining a supply of water as England. The proplem of supplying pure water to every village and hamlet—at which they should aim—could never be solved without a combination of statesmen and men of science; nor could it be solved without compulsory legislation.

Mr. DEACON, engineer of the Liverpool Water-Works, thought that small villages must be supplied by wells, as they could not afford the expense of aqueducts or mains.

Mr. PENGELLY made a few remarks on the legal aspect of the question.

SOCIETE TECHNIQUE DE L'INDUSTRIE DU GAZ EN FRANCE.

(*Continued from page* 370.)

The PRESIDENT called on M. Chamon, in the absence of M. Rouget (manager of the gas-works at Brest), to read the following paper, which had been prepared by the latter gentleman, on

METERS WITH CONSTANT WATER LEVEL.

On the occasion of our last meeting I had the honour of addressing you on the subject of a gas-meter with constant water level, based upon the principle of the saturation of the gas before its entrance into the measuring chamber, and I likewise explained the arrangement I had adopted in order to realize the object I had in view.

Since then I have modified the arrangement of the reservoir containing the water necessary for the saturation of the gas, so as to avoid the inconveniences which had been pointed out to me by some of my colleagues. I refer to the increase in price of the meter, the alteration of the lead work to replace an old meter by one on my system, and, lastly, the objection arising from the dimensions of the reservoir, which was an actual objection, especially in the great centres of population, where space is always limited, and is also afforded by the site of the old meter. In a word, I have endeavoured to produce a meter possessing the same properties as that on which I have already addressed you, occupying the same space as the old meter, and having the inlet and outlet in the same respective positions.

This I have succeeded in accomplishing, under special conditions, by arranging the saturating reservoir beneath the square case of the meter in such a way that this reservoir, which is furnished with partitions, is nothing more than an enlargement of the hydraulic seal of the syphon, and a prolongation of the drum case, of which it takes the form. The meter, therefore, with all its working parts and conditions of action, preserves the shape now generally accepted and even required by gas companies.

My new meter offers a similar advantage to that possessed by the instrument I brought under your notice last year—viz., exactitude of measurement—thus giving gas companies an immediate increase of from 4 to 5 per cent. in their receipts, this increase reaching even to 7 per cent. in the case of meters fixed under special circumstances, such, for instance, as in warm situations. Besides this, however, there is the undeniable advantage of the new meter having the same bulk and outward appearance as the old one.

I feel so much more confidence in bringing these particulars before the society, inasmuch as this meter has stood the test of practice. There are more than 1200 meters on my plan in use in France, and probably as many in Germany. I say probably, as I have not taken out a patent for that country; and information has reached me that they have there met with a very good reception. That will be more easily understood when you call to mind the fact that in Germany there was no such thing as *high level* in a meter, and consequently the gas companies were in possession of the *low level* meter only. There will now be neither the one nor the other, but always a normal level, and consequently *exact registration*.

At the conclusion of the foregoing paper, the PRESIDENT read a letter bearing on the subject, which he had received from one of the members (M. Brunt), who was unable, through indisposition, to be present at the meeting. It stated that while giving credit to M. Rouget for his endeavours to popularize the use of the saturating meter, which was destined to render great service to gas industry, he felt bound to inform the society that its invention took place at a date anterior to that of the patents taken out by M. Rouget, and in support of that assertion he forwarded two specifications of English patents, with translations, which he requested the president to read to the meeting.

M. SERVIER and several other members observed that it was not the society's business to examine into questions relating to the priority or validity of patented inventions submitted to them—that came within the province of the courts of law; they had, in short, only to examine whether or not the systems brought before them possessed any interest for the gas industry.

M. ELLISSEN said that M. Rouget might have rendered the idea of Mr. Reid more practical; that would be a great point, and would ensure the success of the instrument, that is if it answered in other respects, as experiments made both in England and in France in 1862, with English meters constructed upon this principle, did not give satisfactory results.

M. CHAMON added that, in presence of the objection raised by the letter of M. Brunt, he regretted still more the absence of M. Rouget. Besides, he too was of opinion that the question of the validity of a patent should be eliminated from their discussions. In this particular case, however, he believed he was able to affirm that M. Rouget had never claimed the priority as far as concerned the principle of the preliminary saturation of the gas before it entered the meter, with the object of obtaining a constant level. According to him, Mr. Reid, whose patent had been cited as an exception, had certainly thought of a plan for realizing this principle, but he (M. Rouget) had thought of another, the application of which to gas-meters actually in existence offered novel and special combinations, both on the whole and in detail.

A MEMBER observed that the only matter of interest was to consider which was the best arrangement, looking at the commercial result they had in view. In order to afford members an opportunity of acquiring further information on the subject, he requested M. Chamon to exhibit to the meeting a model of M. Rouget's new meter—a request which that gentleman at once complied with.

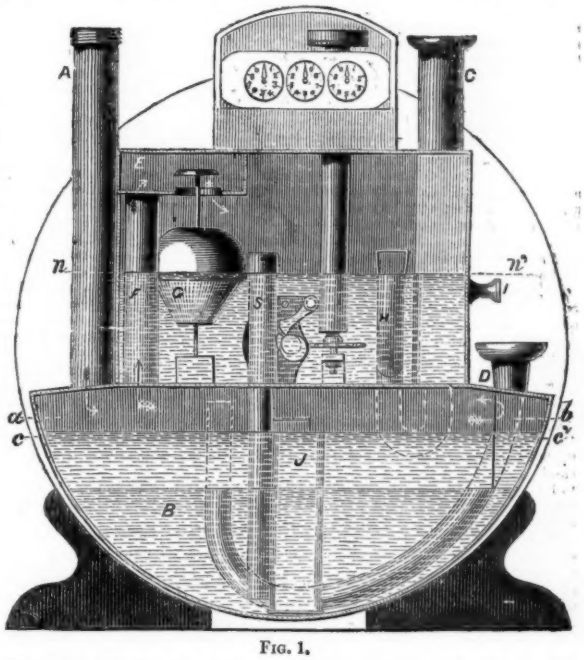


FIG. 1.

The above engraving (fig. 1) shows the general arrangement of the meter. A is the gas inlet-pipe; B, the gas-saturating reservoir, containing the partitions, R (fig. 2), and forming an hydraulic seal to the syphon; C, water inlet to the meter; D, water inlet to the saturating reservoir; E, valve-box; F, pipe conducting the gas from the saturating reservoir to the valve-box; G, the float; H, regulator for maintaining the normal water level at *n n'*; I, screw at overflow orifice at normal water level; J, regulator for maintaining the water level at *c c'* in the saturating reservoir; K, screw at overflow orifice at water level in reservoir; S, the syphon. Fig 2 is a sectional view of the meter at *a*, *b*.

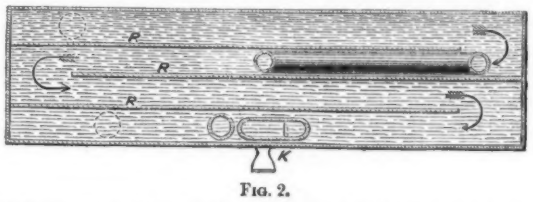


FIG. 2.

The PRESIDENT next communicated to the meeting the contents of a letter that had been received from M. Brunt, on the subject of the exhaustion of gas by means of a jet of steam. He placed upon the table, for preservation among the archives of the society, plans of the Körting apparatus.

M. Eichelbrenner cited several towns in Germany where the use of this apparatus had been abandoned, on account of the large deposit of naphthaline.

M. Feer said that the Körting exhauster worked perfectly well, especially at Chemnitz, where it had been in operation during the past four months, without the production of naphthaline. It appeared simply to require more steam than ordinary exhausters.

The President then requested M. Brémond to read, in the absence of M. Mulot, that gentleman's communication on

MULLER AND EICHELBRENNER'S RETORT-OVENS.

The system of setting retorts adopted by MM. Muller and Eichelbrenner, appearing to me to be about to come into more general use in gas manufacture, considering how largely it has been applied during the past few years, I thought it would not be inopportune at the present time to give the society a few particulars as to the arrangement and working of these ovens, and to point out whatever advantages they may possess.

The ovens of MM. Muller and Eichelbrenner are based upon two principles well known at the present day—viz., the preliminary transformation of the solid combustible into a gaseous combustible in a special furnace, and the utilization of the heat produced for the heating of the air which served to burn the gaseous combustible.

Numerous applications of these principles have been made by Siemens in various manufacturing operations, and notably in gas-making. Considerable advantages have been realized by the adoption of ovens on his system, such, for example, as economy of fuel, and height and regularity of temperature; but their fitting up is so costly that, notwithstanding their advantages, they have not made much way in the gas world; besides which, in consequence of the periodical reversing of the valves, they require rather careful management.

The ovens constructed on Muller and Eichelbrenner's system realize the same economy of fuel and the same advantages of height and regularity of temperature, while they are at the same time of simple construction, easy to work, and relatively inexpensive.

This may be tested by the following brief description of the apparatus:—

In the portion of the oven where the retorts are placed the ordinary arrangement is preserved. The actual furnace is suppressed, and replaced by a grating arranged in steps placed at the rear of the masonry, and surmounted by a hopper of refractory bricks. The hopper is filled with fuel from the upper part, and being of large capacity it only requires charging with coke at very long intervals, say three or four times at the most during the 24 hours.

The fuel having arrived upon the grating, is not completely burned, but rather distilled—gasified. The result is that the temperature rises but little in the furnace; just sufficient, in fact, to transform the mass into carbonic oxide and other combustible gases.

Two rather important advantages result from this low temperature. In the first place, the wear and tear of the furnace will be very slight, and, as you know, it is this wear and tear especially that brings about the rapid deterioration of the rest of the oven; secondly, only a very small portion of clinker is produced, ashes only being formed, thus rendering the work of cleaning the fire-bars less laborious. This furnace is therefore, as I have indicated, a veritable gas generator. The gas products, on leaving this furnace, arrive in a central flue, whence they escape into the oven by a series of orifices. By the side of each of these orifices there are others which give access to the outer air; a combustion of gases is consequently produced at the bottom and along the entire length of the oven, the result being an equal distribution of temperature. The air necessary for combustion, before arriving at the orifices above indicated, is forced to traverse a series of conduits coupled to the flues which terminate in the chimney. In this way the air borrows from the burnt gases a portion of their heat, and, consequently, it is already highly heated on its arrival at the combustion orifices. The result is a considerable elevation of temperature and economy of fuel.

It must be remarked that in this system, where the heating is produced by a combustion of gas, cinders are no longer drawn into the oven; there is consequently no deposit upon the retorts to diminish the transmission of heat and be injurious to good distillation.

This system of heating is very easily applicable to existing gas-ovens, all the alteration required being to mount a hopper at the back part of the oven, and to do away with the old furnace, which could be very quickly effected.

In the arrangement just indicated, the hopper is placed at the back of the oven, and the fire-bars behind the hopper. This arrangement, however, need not be strictly followed, but may be modified according to the conditions imposed by the setting. For instance, leaving the hopper at the back of the oven, the fire-bars may be placed at the side. The hopper may likewise be fitted up at the side of the oven; this latter arrangement has been adopted in cases where several ovens were required to be heated with a single hopper. In such cases dampers would allow of the supply of combustible gas being cut off from one of the ovens when it was required to be extinguished.

Several applications of this arrangement have been made by which perfectly equal temperatures in the ovens supplied by the same gas generator have been obtained. This arrangement may also be employed in the case of ovens set end to end, by placing the gas generator at either extremity of the setting; each double oven may also be supplied by means of a hopper placed outside, against the wall of the retort-house.

The management of the ovens set on Muller and Eichelbrenner's system is extremely simple. The most important point to be attended to in the regulation of the dampers is to work with a very slight, perhaps even with an entire absence of draught. In ovens on this system, in good working order, the flame ought to be seen issuing through the draught-holes in the front of the oven.

The quantity of air necessary for the combustion of the gases is regulated once for all at starting, and, with a little practice, it may be easily regulated according to the length of the flame.

The hopper should be charged with coke three or four times in the 24 hours. With regard to the cleaning of the fire-bars, as combustion goes on very slowly in the furnace, once a day will be found sufficient for this operation. It will thus be seen that the work of heating is much more simple than in the ordinary ovens, and that in those works where carbonization does not go on at night, the heats may be let down during that period without any danger of lowering the temperature of the oven.

As I have already remarked, ovens on this plan realize the same economy of fuel as those of M. Siemens. In a series of experiments conducted at Vaugirard upon several of that gentleman's ovens furnished with recuperators on various systems, the consumption of fuel ranged from 17½ to 18½ kilogrammes per 100 kilogrammes of coal carbonized. The experiments made upon Muller and Eichelbrenner's ovens furnish nearly identical results—18 kilogrammes on an average, but even 17 were obtained in a work where two ovens were heated by a single hopper. These economical advantages are not counterbalanced, as in Siemens's ovens, by the heavy expenses incurred in first fitting up.

If it be desired to ascertain the expense necessary for the transformation of an ordinary oven into one upon Muller and Eichelbrenner's system, the quantity of material required may be estimated as follows:—

Ordinary bricks	7000
Fire-bricks	4500
Special flagstones	100
Three dampers and 250 kilogrammes of cast iron.	

Independently of the economy of fuel realized, this system offers several other advantages which are not without importance. As has been already remarked, the work of heating is simplified, thus allowing of an economization of labour in small works. Besides this the temperature is perfectly regular, which should ensure a longer life for the retorts. This system has been too recently introduced to allow of any estimate in this respect being made from results actually obtained in working; but it seems rational to suppose that the destruction of the retorts will be less rapid.

In conclusion, the dislocation of ordinary ovens appears to proceed generally from the wear and tear of the central furnace, which causes sinkings in every part of the masonry. In the new ovens this element of destruction disappears, since the furnace is isolated from the wall of the oven.

Although this system has been less than three years on trial, it is in use at the present time for the heating of more than 300 retorts dispersed over some 50 gas-works, and the results already ascertained would appear to assure for it a greatly extended adoption.

M. Servier was astonished at the amount of coke consumed per ton of coal carbonized, as given in the foregoing communication, it being very much below the consumption in large works conducted under very favourable conditions. He also expressed a doubt as to its being the result of practical working.

M. Jordan observed that the weight of the coke consumed was an insufficient test of the value of the system; the yield of ash from this coke should also be known.

M. Eichelbrenner confirmed generally the statements contained in M. Mulot's paper. He, however, wished to draw special attention to the nature of the coke, which he said should be well baked. The apparatus would work badly, or not at all, if the coal were not thoroughly well carbonized. In other respects, the gas generator had not been studied with the view of substituting coal for coke, or of utilizing the tar. He referred briefly to some trials of vertical retorts now being made in the works at Montreuil, which led him to hope to see a radical reform effected in the manufacture of illuminating gas, and likewise an alteration in the method of producing the coke, the quality of which might be either metallurgic or domestic as desired.

The President then called upon M. Chevalet to read his communication on

THE TREATMENT OF AMMONIACAL LIQUOR IN GAS-WORKS.

Ever since sulphate of ammonia has entered largely, as a nitrogenous manure into practical agriculture, nearly all gas companies of any importance have undertaken its manufacture upon their works from the ammoniacal liquor produced in gas-making.

The several apparatuses employed for this purpose vary considerably in form, though they are all based upon the same principle, which is that of the separation by heat of the ammonia from the liquor, which holds it in solution, and the fixing of this ammonia with sulphuric acid.

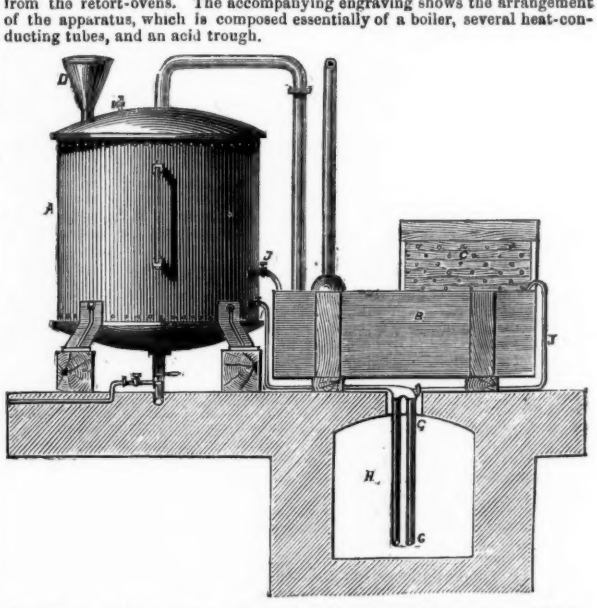
The form of apparatus most generally known is that which was devised some time since by M. Mallet, and which has been applied in several gas-works in France. This apparatus is an excellent one in this respect, that it is capable of producing either volatile alkali or sulphate of ammonia, and had it not been for its high price and rather difficult management, it would have been adopted in nearly every gas-works.

Of the apparatuses that have come into practical use there is, first of all, that of M. Kuentz, in which the ammoniacal vapour comes in contact with the acid mixed with steam, which arrives in the acid bath. Then there is the apparatus of MM. Elwert and Muller-Pack, in which cold ammoniacal gas is conducted into the acid baths, and the basis of which is the adaptation to the distillation of ammoniacal liquors of the distillatory column employed in the production of alcohols.

In order to be worked economically, these apparatus require a rather large quantity of liquor to be treated—something like 4 to 8 cubic mètres (880 to 1760 gallons) in the 24 hours. But, as little more than 1000 to 1200 litres (220 to 264 gallons) of liquor are produced in a gas-work where there is a daily carbonization of 20 tons of coal, it is clear that it would have to be stored until sufficient had accumulated for supplying the apparatus. To the original cost of the apparatus, which is in action during a quarter of the year only, in a work of the size I have alluded to, it would be necessary to add that incurred in the construction of storeage tanks. During this enforced repose the apparatus gets dirty. The action of ammonia upon iron and cast metal work is well known, and when the apparatus is required to be again brought into use, it has to be first put into a fit condition, thereby occasioning some little expense.

The end I have had in view has been to produce an apparatus sufficiently simple in character to allow of its application in almost all gas-works, as much by reason of the small space it occupies, as on account of the moderate outlay incurred in the manufacture of the salt.

The principle of the apparatus I propose rests upon the daily treatment of the ammoniacal liquors as they are produced, by means of the waste heat from the retort-ovens. The accompanying engraving shows the arrangement of the apparatus, which is composed essentially of a boiler, several heat-conducting tubes, and an acid trough.



The boiler, A, has a capacity at least double that of the quantity of liquor produced each day on the works, and the position generally chosen for it is behind the ovens, near the chimney. Into the flue, H, extending from the ovens to the chimney, one or more tubes, forming so many heat-conductors, G G, are inserted. These tubes have a maximum diameter of only 10 centimètres; it therefore follows that the hole to be pierced to allow of their passing through is not required to be very large, so that the draught from the chimney

is not cut off. This heat-conductor is connected by two pipes, furnished with stop-cocks, I J, to the boiler containg the ammoniacal liquor. Into the top of the boiler there is fitted a tube, by means of which the ammoniacal vapours are caused to bubble up under a bell-shaped vessel, E, while another tube, F, issuing from the top of the bell, conveys the steam and noxious gases into the chimney of the works. A funnel, D, furnished with a plunger, serves to introduce both the ammoniacal liquor and the milk of lime necessary for the complete decomposition of the ammoniacal salts contained in the liquor.

The operation is conducted as follows:—The boiler is filled three parts full with ammoniacal liquor, the two stop-cocks connecting it with the heat-conducting tubes having been previously opened. Under the influence of the heat proceeding from the flue, the liquor contained in the tubes is heated, becomes vaporized, and escapes by the stop-cock J. A vacuum is produced in the heat-conductor, and fresh cold liquor introduced through the pipe I. In short, a current of liquor, moving from the boiler to the heat-conducting tubes, and from them back to the boiler, is established.

If sufficient heat is furnished by the flue, the liquor enters into a state of ebullition in the heat-conducting tubes, and the vapour produced then passes into the boiler, where it becomes charged with ammonia, arriving at length under the bell, where it liberates itself by coming in contact with the acid. The bell arrests the acid thrown off, and collects the noxious gases and the uncondensed steam. When about a third of the liquor has been evaporated, nearly the whole of the ammonia contained therein will have been evolved; that is, about 85 per cent. of the initial quantity. In order to liberate the remainder, some weak milk of lime is added by the funnel, D, and this decomposes whatever non-volatile ammoniacal salts the liquor may still contain. The liquor in the boiler is allowed to boil until its vapour gives off scarcely any odour, after which it is emptied by opening the lower tap, and refilled with fresh liquor.

In this way all the ammonia contained in the liquor is liberated by the employment of scarcely the eighth part of the lime used in the apparatus I have previously mentioned. The result is this advantage, apart from the economy of lime, that the apparatus does not get dirty, and may, therefore, be kept working for several months together without requiring to be cleaned.

A part of the vapour given off beneath the bell is condensed, which results in the augmentation of the volume of the bath. The water resulting from this condensation is evaporated by keeping the bath at 80° or 100° C. by means of a serpentine pipe passing round the trough. Through this pipe passes the boiling liquor in its passage from the boiler to the heat-conducting tubes. When the bath is covered with a layer of salt, this salt, which is deposited at the bottom of the trough, is drawn off, and placed to drain on an inclined plane, C, an end view of which is shown in the accompanying engraving.

With this apparatus one or two boilerfuls of liquor may be made in the 24 hours. More than two operations may be conducted; but in that case, a special serpentine pipe, containing vapour at a temperature higher than 100° C., would be necessary for evaporating the mother liquors produced.

The advantages possessed by this apparatus may be summed up as follows:—

1. No expenditure of fuel is necessary.
2. Scarcely any manual labour is required—simply the time spent in emptying and refilling the boiler.
3. The ammoniacal liquor being treated daily, ordinary attention only is required, thus dispensing with the services of a special workman.
4. No tanks are required for storing the liquor.
5. The extraction of quite as much sulphate as by any other apparatus.
6. There being no expenditure of fuel, very weak liquors may be treated, those of 1° equally as well as those of 6° or 7° strength, the latter simply requiring more time for their thorough exhaustion.

When the works have no horizontal flue in connexion with the chimney, a heat-conducting tube is placed horizontally in the passage usually found below the lowest retort.

Should there be no ammoniacal liquor for distillation, the boiler may be filled with clean water, thereby ensuring a supply of boiling water always ready to hand. This apparatus may even be employed as a hot-water stove, by placing the boiler in the apartment to be heated, and setting the acid trough on one side.

No discussion followed the reading of the above communication, which concluded this portion of the business of the sitting.

The PRESIDENT, in thanking those members who had been good enough, by their communications, to contribute matter of interest to the society generally, desired the meeting to bear in mind that as the opinions expressed in the several papers were purely personal, the Société Technique could not, of course, be responsible for them.

PREMIUMS FOR PAPERS.

The proceedings of the meeting were brought to a close by an announcement from the president that the committee had decided to award a premium of 500 francs to the author of the best paper on the progress made in gas industry during the past ten years. After some conversation among the members present, it was decided that the competition should not be restricted to members of the society, but be open to all persons engaged in gas industry.

The following are the particulars respecting these prize papers, and the conditions of competition:—

A PRIZE OF 500 FRANCS,

voted by the general meeting on the 24th of May, 1875. will be awarded to the author of the best unpublished paper, in French, "On the Progress made in Gas Industry during the past Ten Years." This work is to be an exhaustive study, and not merely an historical survey. Each author will be at liberty to treat in a more special manner one of the principal branches of the industry.

A PRIZE OF 250 FRANCS,

offered by a member of the committee, will be awarded to the author of the best unpublished paper, in French, "On the best and most economical means of laying Mains gas-tight, and of discovering and remedying Escapes."

CONDITIONS.

1. All persons, whether Frenchmen or foreigners, members of the Société Technique or not, are eligible to compete.
2. The papers are to be unpublished, and written in French.
3. The papers must bear at their head a motto, which must also be written upon a sealed envelope containing the name of the author.
4. The manuscripts must be deposited in the society's offices, 21, Rue Abbatucci, Paris, before March 1, 1876.
5. All the papers will remain deposited in the archives of the society.
6. The successful papers will be published in the society's annual report.
7. The prizes will be awarded by the committee on the report of a commission of five members nominated by it.
8. The prizes will be awarded in general meeting.

BIRMINGHAM WATER SUPPLY.—Dr. Hill, the medical officer of health for Birmingham, reports that the water supplied to that town in August was "worse than it has been for a long time, having a distinct green colour with a brownish tinge, and an unusually large amount of organic nitrogen."

UNITED GENERAL GASLIGHT COMPANY.—At the half-yearly meeting, held on Tuesday, the 7th inst., the profit for the past six months was stated to be £995, which it was resolved should be carried forward to the next half year towards the payment of the usual annual dividend in April. The vacancy in the office of auditor was filled up by the election of Mr. R. H. Jones, of the firm of Messrs. Anderson and Jones.

AMERICAN GASLIGHT ASSOCIATION.

Mr. T. FORSTALL (New Orleans) having read the paper on "The Proper Preparation of Lime for Use in the Purification of Coal Gas," reported in the last number of the JOURNAL,

The PRESIDENT said he thought the paper was of the highest value, not merely in itself, but in what it might lead to. He hoped the members would thoroughly discuss the question, and ascertain from Mr. Forstall every point connected with his process. His paper became the more striking, as he stated that he used shell lime. If such results could be obtained with shell lime, what might not be done with stone lime?

General HICKENLOOPER asked how it was that the material being so hard, the gas got through it. As he understood the paper, the lime was in the condition exhibited when removed from the purifier.

Mr. FORSTALL said it was. It was removed two hours after the gas was turned off. The gas continued to pass through it in this condition until the purifier was turned off. He had never subsequently turned the gas on again to see whether any change would take place. But the lime was just as hard as the specimen produced when it first came out, and had to be broken with pick-axes. He believed that gas would pass through it with a 2-inch pressure. His maximum pressure was 2 inches on the three purifiers.

General HICKENLOOPER asked whether the mass might not be still moist when the purifier was shut off.

Mr. FORSTALL said there was a little condensed water on the top, which fell from the cover; but the middle layer, which did not get any water, was just as hard as the sample produced.

General HICKENLOOPER asked what kind of screens were used.

Mr. FORSTALL said plain wire screens with one-inch meshes; but the lime used on any kind of tray would do.

Mr. HARBISON asked Mr. Forstall whether he had ever removed the cover of the purifier immediately after turning off the gas, so as to be able to see in what condition the spent lime was.

Mr. FORSTALL replied that he had often done so. In fact, when he first used wet lime he always did it, and found the material always in the same condition. Now he had the covers left on longer as a matter of convenience to the men. There was no fixed time for removing them after the change was made, and occasionally they were left on till next morning.

Mr. HARBISON: Is there any difference in the amount of odour coming from the lime, whether the cover is immediately removed, or whether it remains on for some time?

Mr. FORSTALL: No, I think not. The longer the cover is kept on the box the longer the odour is kept in, and the lime begins to heat as soon as the cover is taken of. There is always a certain amount of heating going on, and then the odours are developed. I do not think that makes any difference.

Mr. EDGERTON: It is simply due to more complete absorption of carbonic acid. The preparation of the lime with a large amount of moisture allows a complete absorption of the carbonic acid. The purification in the centre of the lime nodules or lumps is due to the fact that the excess of moisture allows the transmission of the impurities to the centre. The gas itself has no access to the centre of the lump, but any impurity absorbed at the surface is transmitted to the centre of the lump, owing to its very moist condition. That, I think, I have demonstrated to be the fact by numerous trials.

Mr. HARBISON: In what way does the gas get through, as this is one mass over the entire surface of the tray? If it does not penetrate through, how does it get from the bottom of the pan to the top?

Mr. FORSTALL: It does pass through under a pressure of about 2 inches.

Mr. WILLIAMS: Did Mr. Forstall notice any variation in pressure when the gas was first on and freshly charged—between that time and the close?

Mr. FORSTALL: There is a gradual slight increase from the beginning to the end, but very slight. In those 38 days the increase in the pressure was only about half an inch. The purifiers are 25 feet square.

Mr. WILLIAMS: That is a very large surface, and, of course, the gas would pass very slowly through it, although it appears very hard. Nevertheless, gas would penetrate it, as we all very well know.

Mr. FORSTALL: We did work it in the old purifiers. They were working with lime 6 inches thick during the winter of 1873, and we purified 20,000 feet to the bushel of lime. We had a pressure of 15 inches, as against 18 inches two years before, with only one-quarter of the quantity of lime.

Mr. WALKER: It so happens, from a hint dropped to me by Mr. Edgerton here some year or two ago, that I went to work last fall, having been heretofore troubled with small purifiers. I could not get any gas through without considerable increase of pressure, and I went to work, preparing my lime in this way. (It was stone lime.) The manner of preparation with me has been to slake it thoroughly, and then wet it well down with a hose, pile it in a good big pile, let it lie there for a week or ten days, and break it up with a shovel. I found it very nearly in the condition of Mr. Forstall's specimen at that time. I commenced using it in that way on four trays, about 2½ inches to a tray. I have had great success with it, and no trouble with pressure; I make a great deal more gas, and get it through perfectly easy. I found the lime broke off the trays in cakes like this. I commenced, within the last four months, using two trays, first with 6 inches and then 8 inches, and it comes out in this same condition, and I have no increased pressure from it whatever. My purifiers are small enough for the work being done, but I have not the slightest trouble with it. I think myself that exposure to the atmosphere hardens it a little more, and makes it look more solid. When it comes out I have to take a shovel, and break it up. We have been purifying about 8800 feet to the bushel of unslaked lime. This is the best I can do with it. We use Youghiogheny coal. I have had great satisfaction in using lime prepared in this way, and it shows like this specimen when it is thrown out into the yard.

A MEMBER: What did you formerly get? 9000 feet per bushel does not seem to be much, compared to Mr. Forstall's experiment.

Mr. WALKER: I know it. I did not get more than 5000 formerly. I should like to know the difference between shell and stone lime for purification.

Mr. SUTTON: I have been in the habit for 10 or 15 years of buying stone lime that is slaked and prepared for agricultural purposes. I now buy unslaked lime. On the Hudson we buy it for about 5½ cents per bushel. We used to think we could not use anything but slaked lime. I think we purify about 5000 feet to a bushel of lime. I do not think we ever purified over 6000 feet with a bushel of slaked lime.

The PRESIDENT: I should like to have Mr. Breese state his experience in this connexion.

Mr. BREESE: Some 18 months ago I heard that Mr. Forstall was purifying 48,000 feet to the barrel. I never like to hear of any one doing any better than I want to do myself, and I went to work on the lime. I think the best policy is to buy unslaked lime and slake it yourself. Mr. Sutton might buy lime that was slacked in the kiln, that would make nothing by wetting down; but the lime that we buy slakes about 2½ bushels to the bushel of dry lime. I do not think I do good work unless I purify from 35,000 to 40,000 feet, and I have purified 48,000 feet and over to the barrel of slaked lime. Mr. Lewis, our president here, will furnish you with the data to show that we did not run less than 30,000 feet right along. I do it on the same plan that Mr. Forstall pursues. I wet my lime down and shovel it over. It is so wet that when I wheel it in in wheelbarrows there is from an inch to an inch and a half of putty sticking on to the wheelbarrows, and the men before they go home kick it off their feet.

In reply to a number of queries by the PRESIDENT,

Mr. BREESE said he purified 75,000 feet of gas to a barrel of stone lime. His pressure gradually increased always after running a box from eight to twelve

hours. After that there was no increase. The pressure rose from 4½ to 7 inches, after running from six to seven hours. His purifiers were 25 feet square. He used the lime before recharging four days—sometimes six—depending upon circumstances. In Detroit the authorities were changing all the cobblestone pavements into wooden ones, and they gave him cobblestone lime, which was inferior, and necessitated a change oftener.

Mr. LITTLEHALES asked how much of the 4 inches of pressure was due to the gasholder, and how much to the purifiers.

Mr. BREESE: As soon as I change my purifier I have 4½ inches of pressure, and for the first three or four hours the pressure is only some 3-10ths or 4-10ths of an inch perceptibly different. But in about six hours it runs up to 5, and from 5 to 7 inches, and runs along in that way until the latter end.

Mr. LITTLEHALES: How much is the lime on all your trays?

Mr. BREESE: From 2 to 2½ inches. There are seven courses of trays in the box.

The PRESIDENT: Has your gas been analyzed lately, that you know its purity?

Mr. BREESE: There are three or four gentlemen here who have been to Detroit this winter, and analyzed the gas. I would rather they should give their opinion.

The PRESIDENT: Have you a system of inspection in the city?

Mr. BREESE: The system of inspection is simply the ordinary system of using test-papers that are used in gas-works usually. Test-papers are used every morning and every evening.

The PRESIDENT: Do you prepare the lime some time before you use it?

Mr. BREESE: No. I frequently use it while it is hot—that is, while it is steaming. I would rather use it that way than any other. If I can take my lime, slake my barrel of lime, and put it immediately on my trays and close my box, I can gain from 6000 to 8000 feet more to a barrel.

The PRESIDENT: How many bushels do you put into each purifier?

Mr. BREESE: I put about 300 bushels. The maximum make of gas in the winter is pretty close to 600,000 feet. Our purifiers are 50 inches in depth. We use Youghiogheny coal and Ohio cannel as an enricher—from 18 to 25 per cent.

Mr. LITTLEHALES: What is your preparatory treatment of your gas before it comes through the purifier. Do you wash or scrub?

Mr. BREESE: I scrub and wash both, and run the gas through about 250 feet of 20-inch main-pipe.

Mr. LITTLEHALES: I think that is where the secret lies. It is a well-known fact that if you pass the gas through the purifier very slowly, the lime will absorb two, and even three fold the amount of impurity that it will when it is being forced through rapidly. You may also scrub and wash out fully 50 per cent. of both the suphuretted hydrogen and the other impurities of the gas, and you also take out the ammonia by the washing and scrubbing, which you do not free it from so well by any other means. Has Mr. Forstall any system of either scrubbing or washing, for I believe that is where the secret lies?

Mr. FORSTALL: The stress I laid was not upon the actual duty of the lime, but upon the difference produced by the increased moisture. The other conditions were the same in both instances. Our condensation is just as slow as we can make it. We use scrubbers and washers, or rather they are combined; but from the time we used the dry lime until we used the wet there was no change made in the other circumstances of purification—in the condensing or scrubbing processes—nor was there any change made in the manner of putting the gas through our purifier, and in every case it worked up through.

Mr. LITTLEHALES: My own idea is this, that the true explanation is in the gas being allowed to pass very slowly, and scrubbing. Some American engineers, I know, are very strongly prejudiced against water. As Captain White explained at our last meeting, he thought every drop of water would spoil the gas. I believe that is altogether a mistaken idea. I might quote you one works where they have been trying very hard to purify the gas lately by the scrubbing and washing process, and after passing through six scrubbers in succession, they found the loss so trivial as not to be worthy of consideration. They succeeded in purifying their gas wholly by scrubbing and desulphurizing the ammoniacal liquor, and using it over and over again, it having great power to absorb the sulphuretted hydrogen. The simple reason that it was abandoned was that it cost more to desulphurize the liquor than was saved. But that gas can be purified to a large extent both by water and ammoniacal liquor there is no doubt; and I believe in both those cases it is due more to the preliminary treatment of the gas than to the difference in the lime.

Mr. FORSTALL: The preliminary treatment having been the same at both times, the difference between one set of figures and the other set must be due to the only difference made, and that was the wetness of the lime.

Mr. LITTLEHALES: The water is doing the duty after all.

Mr. FORSTALL: Well, water is cheap and lime is dear.

Mr. LITTLEHALES: Yes, but I believe you would accomplish precisely the same results if you did not wet the lime so much. We can only manage to purify about 12,600 feet in Hamilton with Canadian lime—good stone lime. That is per lime-burner's bushel unslaked lime; about 75 lbs. to the bushel.

Mr. BREESE: I wish to explain one little circumstance here which I had forgotten. We have two sets of washers or scrubbers, and two sets of condensers, besides the 250 feet of 20-inch main-pipe, and the gas passes all through this before going to the purifiers. The gas passes through one set of dry scrubbers. They have screens in them. They have a set of dry screens in each one of them. After that there is a spray condenser. There are then two sets of condensers which are both run dry, without any water. We never run any water in them at all, and have no occasion to do so. By examining the gas after it comes from the condenser, I find it much more pure than I used to before the two sets were connected together.

Mr. M'NEAL: Whenever I ask a gas engineer how many feet of gas he will purify to a bushel of lime, I mean, "How many feet of gas do you purify to a bushel of lime put in your purifiers?" That is the standard, and I am delighted to find that my purifiers work so well. I have discovered that, instead of 5000 feet to the bushel, I purify 10,000. Mr. Forstall says that oyster-shells converted into lime will expand, so to speak, and that one bushel of oyster-shells will yield a little less than two bushels of lime. Now, I take those two bushels of lime and put them into a purifier, and I say one bushel of that lime purifies 5000 feet. I am delighted to learn here that I purify 10,000 feet to the bushel. I think, when we speak of the purification, we do not mean lime in a shed, or 10 miles off, but the lime that we put in the purifier. You put 100 bushels of oyster-shell lime, or lime from paving-stones in the street, into your purifiers, and the purification is at the rate of 5000 feet to a bushel; you purify 5000 times 100—500,000. That is the standard, as I say, not of lime in a shed, but in the purifier. Now, there is some difference or discrepancy here. One takes the unslaked lime and reckons it before it goes into the purifier, and the others say that it purifies so much of lime in the purifiers. Let us have one standard.

Mr. A. SUTTON: From the books of the Manhattan Company of New York, it appears that they purify 6420 feet to a bushel of lime—oyster-shell lime—I presume slaked lime; Fairmount coal, 2282 feet; Sterling coal and Ohio coal, I believe, is put down at 3993 feet; another West Virginia coal is put down at 2480 feet; Clover Hill coal, 3322 feet; Newcastle coal, 3500 feet.

Mr. WALKER: In discussing this matter of the quantity of lime we have lost sight apparently of the main question—the preparation of the lime.

Mr. EDGERTON: I think Mr. Littlehales is right in attributing the increased result to water in the lime. It is in this way that it enables the lime to do the greater duty. It enables the lumps as they form to absorb the impurities to the centre. If you place a lump of prepared lime on the top tray of the purifying-box when going into action, and take it out as it comes round in turn, you will find, if the preparation of the lime is proper, the purification has gone on to the centre, and it will be saturated with either carbonic acid or sulphuretted hydrogen. The hardness of the lime is due to converting it into a sort of limestone again, and that can only take place when the lime is decidedly moist. That is clearly the reason why the moist granulated form of lime has greater action on the gas than the comparatively dry. So that really the moisture does not absorb the impurities, but enables the lime to do its proper work.

Mr. CRENSHAW (to Mr. Forstall): Do you apply the same tests to your purifier before changing as is ordinary?

Mr. FORSTALL: We use the turmeric paper test for ammonia, and sometimes the nitrate of silver solution for sulphuretted hydrogen, but we are in the habit of running our purifiers until every layer of lime will soil but the last one. We have test-cocks between each layer of lime in the purifier, and I think one of the reasons why our sulphur impurity is so small is because we have followed Mr. Anderson's plan of running the purifiers as long as we possibly can before making changes. That, however, does not affect the purification from sulphuretted hydrogen at all, but merely the purification from bisulphide of carbon, and I did not say anything about it, because I wished to confine myself to one single point in my paper. The manner of working the purifiers I consider has nothing whatever to do with the manner of preparing the lime for the purifier. We, however, make no change until every layer of lime in the three purifiers but the last one will soil. The man watches that last one closely, and as soon as that second layer soils in the last purifier, leaving in one clean layer, then he makes his change.

Mr. WALKER: I said I got 8800 feet. I will state the way I work it to give gentlemen an idea, and to compare the difference between the two systems. I test by the middle purifier always, leaving the third always clean. I change whenever it soils on the second purifier.

Mr. M'NEAL: I propose a vote of thanks, with all my heart, to Mr. Forstall for his able, instructive, and exceedingly interesting paper.

The motion was unanimously carried.

EVENING SESSION.

The PRESIDENT said he would suggest as a topic of discussion for the evening, the economical use of tar as gas fuel. There were gentlemen present who had had experience, and who could perhaps tell them how they were using it, and with what results. He called upon General Hickenlooper to give his experience.

TAR AS FUEL.

General HICKENLOOPER said he was totally unprepared to make any remarks on that subject, and would prefer to postpone it until some other occasion, when he could give statistics in regard to it. Still, he would say this much, that about two years ago the accumulation of coal tar was such, at his works, as to be a formidable matter, amounting to 18,000 barrels. There was no market for it, it was impossible to get it off at any price, even to give it away; so that it became a matter of necessity to devise some way to get rid of it. They commenced by attempting to use it as it had been previously used in other works—by injecting it in connexion with steam, and occasionally firing up by coke. They found, upon trying it that way for some time, that it consumed the tar, but gave no equivalent return, and they had to fire continually with coke. It finally resulted in the adoption of a plan which he would endeavour to roughly describe, and which they were using now. They had sealed its value at the different values of coke. They were now selling coke at 6½ cents a bushel, at which price the tar netted 1·75 dol. a barrel for fuel. The most essential feature necessary to success was to keep the tar perfectly free from mixture. To effect that they arranged to keep it entirely under cover—perfectly dust-tight, going from the different receptacles into the well, which had been covered with a dust-tight roof. It was pumped from these with a small steam-engine to the tank, which was a boiler raised 3 feet above the end of the benches at the end of the retort-house, from each end of which ran along the base a pipe 1¾ inches in diameter. At each of the partition lines on the benches there was a branch-pipe running down, terminating by an ordinary stop-cock that discharged into the funnel, from which a pipe led into the iron trough, sloping at an angle of 30° with the horizon. Immediately underneath the tile was a fire-brick arch, for the purpose of protecting the tile from the excessive heat of the tar. In starting the bench the coke fire had to be built under this arch, which corresponded to the ash-pan of an ordinary bench, the spring of the arch being from the top of the ash-pan. That heated the arch and the tile red hot, upon attaining which heat the tar was run on and fell into the spout and on to the tile, where it was vaporized, the unconsumed portion was consumed before it reached the bottom, and aided in combustion at that point by red-hot air (as he might term it) which passed in below the arch and above the coke. On striking the inclined tile it formed a coating, which was pushed back by the man in charge, with very a light stoking iron, and drawn forward to the front through the arch below, keeping a hot-bed of coals underneath, from which, and between which and the top of the arch, the air necessary for combustion passed. That produced perfect combustion, so there was a steady stream of tar flowing, about the size of a knitting-needle, which ran from one month to another, and required no attention except to push back this coating.

A MEMBER: Do you stop it on Sundays?

General HICKENLOOPER said they had not yet stopped on Sundays. Some gentleman present announced that his gas arrangement would run without any attention, except some attention to the fires. Now, their gas would require some attention, but no attention the fires; but if they could combine these things together, they could let the thing run itself.

Mr. RICHARDSON said at his works they had been using a very simple form indeed—merely pumping the tar up into the cask on top of the benches of retorts, so as to give a pressure on the pipe, and bringing down a half-inch pipe in front, on which was placed a valve for regulating the flow. One end of the pipe which conveyed the tar into the furnace was reduced to about one-eighth of an inch—the tar from which flowed into a trough placed at an angle of about 60 degrees, fixed in the front wall of the bench, about 10 inches down the door frame. The trough was made of sheet iron, one half circle of 2½ inches diameter, and extended to the inside of wall. At the point of the one-eighth inch application, and in its rear, they had a small jet of steam, partly superheated, which carried the tar into the furnace in a fine spray, where it instantly became volatilized and consumed. In the furnace door a hole of say 3 inches diameter was cut, and this was covered with a slide, the object of which was to regulate the quantity of air necessary for the proper combustion of the fuel, and for allowing the introduction of a bar for any necessary purpose. Since they commenced the use of tar, they had used no coke. They found there was a sufficient deposit of lampblack in the furnace for their purpose, and with no accumulation beyond that which was necessary. They were led to its use from economic principles—its sale had almost ceased, and their tanks were full. He would state that although their coke sold for only six cents. per bushel, the quantity often used, its heat and that of the amount of coke necessary being equal, was equivalent to selling it for 1·25 dol. per barrel. He would say further that any desired heat could be kept up. The above system had been in use since last winter, and they found no extra deterioration of retorts.

In reply to a member, Mr. RICHARDSON said the bench would not supply its own fuel.

Mr. WALKER said about three years ago he found their contractors would

not buy the tar any more. They said it was not worth anything; they could buy pitch. He then rigged up two benches for furnaces, took out the grate bars and built them up solid, with a sloping furnace, and started away. It did not get along very well because the man was determined it should not work, and he (Mr. Walker) was determined it should. He finally succeeded well and started another bench. He used to run it in the same as General Hickenlooper mentioned, and had no difficulty with it. Some of the folks found it was better to buy their tar. Some of these gentlemen were running similar works, and they wanted to use the tar too. He had used it a great many years ago, along with coke. He would say when you use it along with coke, use it in just the same way—let it run in, but do not stir the fires while using. For instance, you can use all the tar by having a little moveable spout that goes in at the top over the door, about 2½ inches square, and when you have done using your tar, when you have no more to use, just draw out your spout and close up the hole. The pipe will burn off if you stick it through the hole. A little cast-iron shoot is the best thing. Do not stick it very far in. If it goes in too far you will burn off the end of it. A little carbon or coke will gather on the end of it, but you can push it off with a chisel. That is the way to use it.

A MEMBER: Will a barrel of tar carbonize a ton of coal?

Mr. WALKER: Yes; with the tar furnace alone, without any coke. I found in some parts of the old country that is what they are using. They have not made any improvements there in 30 years in using coal tar.

A MEMBER: Then where three benches are being used, one would be enough to run with tar?

Mr. WALKER: Yes. That is about all you can do, and barely that.

A MEMBER: Do you have any smoke?

Mr. WALKER: Not if you regulate the quantity of air. I regulate the proper quantity of air by a register in the door to open and shut. There was a very little air went in where the pipe went in; but I depended mainly on the hole in the door. You must admit sufficient air to consume the carbon. There is no accumulation of carbon on the outside of the retorts.

Mr. NETTLETON: It is something over three years since I began to burn tar under my retorts. My way of burning it is substantially as others have described it. My tar runs into my tar-well, and there gathers a sediment somewhat, so that it was obstructed in the delivery-pipe from time to time, and I had to put a grinding appliance in, in order to make it run a uniform steady stream. I think the price was 10 dols. that I paid for it. I found (or my men did), in use, that we got better results by burning about half the usual quantity of coke with the tar, than when we burned tar only, or coke separate from the tar. We made a very careful estimate of what the tar was worth per gallon to burn for fuel, so much so that when we had an offer of three dollars a barrel for our tar, the contractor offering to furnish his own barrels and do his own pumping, we told him it was worth more for us to burn under the retorts than it was to sell to him at that price, getting 12 cents a bushel for our coke. That is my experience. We get a more uniform heat, and absolutely better results, in the making of gas when we use tar, than when we use coke only.

A MEMBER: I have no tiling under my retorts; I set them entirely on skeletons. Would there be any trouble in its going directly on the retorts?

Mr. NETTLETON: Yes, I am satisfied there would. The tar would act in the nature of a flux, at the point of contact, and eventually make a hole in the retort. I put it in directly over the furnace door, and run it back so as to strike on the coke, 4 inches inside of the wall. I use an ordinary tile. If I put in a piece of cast-iron, as some have suggested, it would burn off. We put in a piece of tile and it stays there, and when we do not want to burn tar we put some luting material in the tar orifice, and then burn coke. It can be changed quickly.

Mr. WALKER: There is no necessity to burn the retorts out any more with coal tar than with any other fuel. You must adjust the quantity of air and carbon, so that the carbon will be entirely consumed. Some think it is all the same to mix the tar and coke before putting it in. They will find out it is not. They will soon get a bench melted down in that way. I have seen it tried and it soon gave out—the retorts, furnace, and everything else. I would not advise anybody to try that experiment. You can adjust the quantity of tar to keep your heat, better than with the coke.

A MEMBER: The flame from the tar will not be likely to injure the retort any more than from the coke?

Mr. WALKER: No.

General HICKENLOOPER: On the contrary, you get a better heat, because you do no not have to open your furnace door.

Mr. BREESE: I have an arrangement for burning tar, by which it is not necessary to have a tank on the top of your benches, or anywhere else. The grate-bars are simply covered over with ashes and the sweepings of the floor, and the tar-burner itself is introduced immediately over the furnace door, and you stop up the hole. There are very few gasmen or gas engineers but what leave stopper holes immediately over their furnace doors, for cleaning out their furnace or their flues—sight-holes is the proper name given to them. I introduced a half-inch pipe into that hole, took out the stopper and put in a Gifford injector, and with that I can raise the tar from the well outside my retort-house anywhere within the limits of an ordinary pump. I have never had an opportunity of raising it over or above 10 or 12 feet, but I have raised it 10 or 12 feet. But in my way of using it the heat becomes so intense that I have to introduce air, and I have an air-cock on the tar-pipe. There are two jets precisely like a Gifford injector, and on the tar side of the pipe I have an air-valve by which I regulate my supply of air so as to control the heat, and it answers about the same purpose as a blow-pipe. Mr. Walker says it cannot very well burn out a clay retort. But in the way I manage it, you can burn out almost anything, and the trouble is to keep your heat regulated so as not to burn your bench out. The *modus operandi*, under which I burn it, requires no tank over your benches, if you do not want it. My drain passes from the purifying-house and from the condenser-room to the washers, taking in all the drainage from the works, and I get not only that, but I get that from the water-closets which the men use, and in which there is a large amount of paper and refuse matter, that will not run through the pipes very well, unless I have a tank up above from which I can feed. And yet I can take the manure from the stable and force that through the pipes. I use a little jet about the size of a darning-needle for my steam, and one-eighth of an inch for my tar, and I regulate the whole supply with my steam. I can draw the heavy tar about 10 feet. Mr. Price, our president, has been recently looking over my arrangements for burning tar, and knows something about the heats I get. I have experimented on both the crude oil and naphtha, and can burn anything in the shape of liquid fuel in that sort of arrangement. It is precisely on the same principle as the Gifford injector. I can raise my liquid fuel to about the same height, proportionately to the weight of the material. Tar being heavier than water, I cannot raise it as high as water, but I have raised it 10 feet. It requires nothing on the grate-bars. I have a man to sweep the floor up and throw the sweepings on the grate-bars, and the desideratum is to keep your grate-bars covered up with something that offers no fuel at all. You have all been into barbers shops at some time, and those india-rubber bags that they force the perfumery on to your faces with, act on the same principle precisely. It forces it into the bench in precisely that same way. It forces the tar into the bench in so fine a stream that, if there is no fire in there, you do not see the tar at all. But, if the bench becomes hot, it looks like a solid belt of stars. It is a perfectly white heat.

The PRESIDENT: What is the economical result of it?

Mr. BREESE: I will give you the result of last month. I burned last month under nine benches 225 barrels of tar, saving 6000 bushels of coke in reality. Coke with us is not a very saleable article, neither is tar. We get 1·25 dol. per barrel for tar, and for coke we get 7 to 8 cents per bushel. We have a contract at 1·25 dol. to take all the tar we make, but, according to the way I have been running it, it does not pay to sell tar at any less than 3 dols. a barrel at our works. But, if you work exclusively on your hydraulic main (which I did on the first start), you will do as I did. I unsealed every one of my dip-pipes. I had a great deal of trouble by taking my tar from the hydraulic main, so I took it from the tar-wells, after having provided an overflow for the water and refuse material.

Mr. WALKER: How much coal do you carbonize per bench with your tar?

Mr. BREESE: I could not say precisely the amount of coal, but I cannot go over 5 dols. per bench a day for fuel. I am running now 16 benches. The trouble is that I cannot very well, without considerable attention, keep my benches cool enough in working the tar in that way, without working quite a quantity of air.

The PRESIDENT: Do you intend to leave the impression, on the whole, that this is too hot a fire?

Mr. BREESE: It is too hot without the air. It is not possible to use the coal tar in that way unless you have some way of admitting air. Where I introduce my tar-pipe I leave a square 4-inch opening for the purpose of keeping down the heat. Mr. Walker speaks about smoke. Sometimes we have smoke, and sometimes not. We do not pay any attention to that at all. We pay attention to the heats and the amount of tar consumed. We burn a barrel and a half of tar, or a little less (I will say a barrel and a half as the maximum), to the 24 hours per bench.

The PRESIDENT: How much coke do you use?

Mr. BREESE: From 40 to 45 bushels—43 bushels on the average. We retail our coke at 10 cents a bushel usually, where the people come to the works and get it in quantities of from one to five bushels; but we base our calculations on seven or eight cents a bushel, at which price we sell it in larger quantities. We have two boilers at the works, and during this excessively cold winter we have been more or less troubled with the cold, and have only on one or two occasions used two boilers. I think, as near as I can get at it, taking the winter through, that we have used from five to eight bushels of coke under the boilers per day—I mean 24 hours. There is no extra labour in using coke under the boilers. The same man who runs the exhauster runs the boilers. But the fuel has been increased from five to eight bushels, depending on the weather. The retort-house, in which the steam and tar are used, is about 125 feet from the engine-room, and I have had the steam-pipe leading to the tar-benches frozen up once or twice during the winter, when the thermometer was 18° to 22° below zero, and run along for months about 8° below zero.

Mr. WALKER: Will Mr. Breese tell us what his yield is? I want to get at the quantity of tar he uses, and the quantity of coal he carbonizes. I want to ask his yield per pound, if he has no objection to answering it.

Mr. BREESE: I get over 5 feet, but that does not cover what I use. I had rather be excused from entering into that discussion. On my coal benches I use naphtha and coal in conjunction, and we average over 5 feet. I cannot claim any advantage from laying off on Sunday; but we run from 5 to 5¼ feet. I am running one bench of fives on naphtha. I make a little over 5000 feet per retort on the coal benches.

Mr. EDGERTON: I think more explanation is necessary in regard to the different results. Figuring it out as the saving of 6000 bushels at 10 cents would be 600 dols., and 20 dols. for the tar; or taking the result of one barrel of tar per day at 1·25 dols., as against coke at 44 bushels at 10 cents, is 4·40 dols.—which is quite a little item of difference in the result. The result for a longer period of time is considerably less than that for a day.

Mr. BREESE: There is one consideration that has been left out. You do not take into consideration at all the labour. I run nine benches, and the same man who runs the nine benches on tar attends to the coke fire; and, in fact, it requires no attention at all. Mr. Price was there a short time ago, and remained two or three hours, and I do not think, during the whole time he was there, there was a man who looked inside the door of the fire. My calculation is that a month's gain, labour included, was, if I recollect rightly, about 219 dols. in round numbers, burning tar. We do not make enough to run all the benches. If I could run the whole of my benches on tar, one man would run the whole 24 benches, and attend to the whole of that business, so far as firing is concerned.

PURIFICATION OF GAS BY OXIDE OF IRON.

Mr. HELM: Mr. President, I have heard some gentlemen express a desire to hear your experience in regard to purification.

The PRESIDENT: I may say that, not anticipating anything of this kind, I neglected to bring with me any statistics; but I can inform the association what we are using, and my general impression of the result. We have been using, for a year perhaps, a combination of oxide of iron and sawdust, and also slaked lime. We use them in the proportion of one-third of each in weight. The bulk consists of one-third in weight in iron, one-third in weight in sawdust, and one-third in weight of lime. We also use, in wetting up the compound, dissolved copperas water. It purifies very nicely indeed. Our gas is very pure. We have had, during the last year, a city inspector, who is a competent chemist, and he has reported our gas as pure. We have made very good gas during the past winter. It has run from 15 to 17 candles—averaging 16 candles certainly. We use this material over and over again, of course. We have not been obliged to renew that which we commenced using more than a year ago. Of course the cost is very low, but I cannot give you the exact figures, as I should be happy to do if I had them with me. We like the system very much. The only objection we find is, it takes a pretty large amount of space to spread the contents of the different boxes as they come out, and give them time to revivify. The revivification process is rather slow, and it takes considerable space. That would not be a matter of importance to many who have room.

A MEMBER: Does it take as many men to manage that as it does lime?

The PRESIDENT: About the same number. I think the saving in labour is not much.

A MEMBER: You think it is quite as economical as lime.

The PRESIDENT: It is much more economical than lime. I should say, however, that our method is this. We lay on the tier of trays near the bottom—within 4 or 5 inches of the bottom of the box—and then fill in by wheeling in with a wheelbarrow, until we fill the box up—say, 2 feet—just upon this one tier of trays. Then we spread another tier of trays, and put on about 2 or 3 inches of slaked lime to take out the carbonic acid. That is all we put in. I do not find that that increases the pressure. The sawdust holds the lime and iron in such a way that there is plenty of room for the gas to percolate through, and the pressure is not increased.

A MEMBER: What is the per centage of carbonic acid in your gas?

The PRESIDENT: I cannot tell you that; I know it is very small. When in Paris last November, I went to the large works where they employ 1200 men, and I found they were using what seemed to be identically the same thing. The superintendent could not speak English very much, and I could not talk French very much, therefore could not explain ourselves and our ideas to each other; but I examined the material, and was satisfied that it was precisely the same as we were using. The gas in Paris gives a white and beautiful light, but it seemed to me when I returned that ours was as good, and I believe the gas we made during the last winter was as good as that used in Paris, and we

use the same system of purification. Mr. Helm, you saw the gas of Paris, what do you say of it?

Mr. HELM: I should think your gas was quite as good. It did not strike me as being any better than that we have here. I think they work with a little heavier pressure than we do here.

A MEMBER: Do you have any trouble with your boxes of oxide, the overheating of the boxes? Is there any danger of its taking fire if left in the box over night?

The PRESIDENT: No; we have not had any trouble since we have learned how to handle it. But when we first began to use it our men did not understand it very well; and in one or two cases (not in the box, but out in the space where it was revivifying) it heated and actually took fire. That was entirely on account of a want of knowledge how to manipulate it.

Mr. BREESE: We have had one or two fires in the box, and I should like to know something more about it.

Mr. SUTTON: We have used it for four years, perhaps, and I tried different ways about it, but I finally adopted this plan. I take a bushel of iron parings and a bushel of sawdust—not from any reason why I should do so, but I thought I must fix it with something to keep it open and prevent its getting solid. I took these two, mixed them together, and I took the liquor from the gas-works and put it upon them, and for four days it worked, then got cold, and was ready for use. We commenced using it, and after revivifying I noticed it grew weaker. It would revive, and we could use it over, but it grew weaker. We then adopted the plan of adding a little iron at each revivification, to prevent its running down. We never mixed anything with it, and we kept on for years using the same material. We took away the poorest of it and threw it out, because the bulk keeps increasing and we have to get rid of some of it. But we had added to it 12 or 15 bushels more, or perhaps 100 lbs. of iron parings, sometimes 75 lbs., sometimes not so much, and we have worked that for years. I have heard a good deal about the illuminating property of the gas being injured by it. I do not believe it is. I have not any positive experiments to relate, but I tried this plan. I took a fixture and put a light on each end, with a burner of exactly the same size on each end, the one I run through the lime and the other burner came direct without passing through the lime. With the eye I could not detect any difference at all, though I had a six-foot burner.

Mr. SHERMAN: My experience in taking out carbonic acid apart from sulphur is, it takes about as much time as it does to remove the carbonic acid and the sulphur together. It is no saving if you take out the carbonic acid.

Mr. BREESE: Mr. President, did you ever test your gas for carbonic acid impurities?

The PRESIDENT: We have no means of testing ourselves, but the city gas inspector, who is a chemist, did test it. The facts that are inquired for might be of some interest, and I will endeavour to communicate through the *American Gaslight Journal* what the results are. I regret I did not bring the facts with me.

The SECRETARY (Mr. Nettleton) read the following paper on

LEAKAGE.

Mr. President and Gentlemen of the Association,—I propose to communicate a few thoughts on unaccounted-for gas, and a mode of its computation.

Unaccounted-for gas is one of the stern and practical realities which every gas engineer meets daily in his work. No company, however perfect their manufacturing and distributing apparatus may be, is free from its evil effects, and to others less fortunate in condition, the prosperity of the company is seriously injured by it, and not unfrequently it is the cause of absolute ruin financially.

Confessedly this is a subject in which all manufacturers of gas are deeply interested, as with unrelenting certainty the value of the gas which has disappeared in this unaccountable manner, appears at the end of each month or each year in the profit and loss account, on the wrong side of the ledger, as so many dollars and cents vanished, leaving nothing as its equivalent.

It is not expected by this paper to add anything new to the gas knowledge of the day, but rather to lead to beneficial results by the bringing of the subject before the association for discussion, in order to discover the best remedy for the evil, and that a partial check at least may be put to this continual every-day disastrous strain.

For a proper consideration of this subject we must define, with some degree of exactness, what we mean by "unaccouted-for gas," and to do this, some preliminaries have to be settled.

1. The station-meter. It is the initial point as to quantity, upon which all the other points of the problem depend. That being so, it becomes a necessity that the station-meter should be as well made as the mechanic arts and our mechanic skill will permit. The water-line in it must be determined with the nicest accuracy, and the water uniformly kept at that line. The past experience of gas engineers has established, as a rule of comparison, that the gas must pass into the station-meter at a temperature of 60° Fahr., under a barometric pressure of 30 inches. A variation above or below this temperature will make a difference in apparent quantity of 1 foot in every 490 feet passed at the meter. For convenience sake we will call it in round numbers 1 in 500; 2 feet in every 1000. For every fall or rise in the barometer of one-tenth of an inch, a difference is made in the apparent quantity of gas passed at the meter of 3½ feet in each 1000 feet.

Now, having got our starting-point settled, by getting the gas manufactured accurately measured by the station-meter, we may make a more precise definition of the term "unaccounted-for gas," as we propose to use it. The quantity of gas registered by the consumers meters may be termed accounted for. The quantity used by the street-lamps may also be termed both accounted for and paid for. The gas used at the various offices of the company, and also at the gas-works is, properly speaking, to be classed as accounted, but not paid for.

These three several quantities being aggregated and deducted from the quantity indicated as having passed the station-meter, the difference is, strictly and properly speaking, the unaccounted-for gas. Some of the unaccounted-for gas is actual, and other parts of it apparent only. The actual unaccounted-for gas is chiefly caused by three sources of loss—one, leakage from the mains and the service-pipes; another source is the gas consumed at the street-lamps, over and above the quantity measured or estimated to have been so used; and the third, consumers meters often run too slow, and do not register all the gas which passes. A thorough overhauling of all suspected meters without delay, and of all the meters used, in every three or four years, should be made by every company, as the remedy for this part of the evil. Apparent loss of gas may come from several causes. One, the water may be too high in the station-meter, causing it to register more than the proper quantity, and, apparently, a very large yield per pound of coal. Another, the gas may have passed the station-meter at a temperature above the 60° Fahr., and thus the quantity apparently be increased by 2 feet on every 1000 for each degree of temperature at which it is passed above the 60°. Another, it may have passed the station-meter while the atmospheric pressure was less than that of 30 inches, and thus be increased 3½ feet for every fall of 1-10th of an inch barometric pressure below the 30 inches. On the other side, it should be mentioned that, if the gas passes the station-meter at a temperature below 60°, the proper quantity is not registered, but a less quantity would then be registered. The quantity of gas is also affected by passing through the main-pipes and consumers meters at a different temperature to that at which it passed the station-meter. If it is passed through the consumers meters while the pressure of the barometer remains the same as that at which it entered the holder, through the station-meter, no apparent difference will arise.

The gas is supposed in practical working to pass the consumers meters at or about the same temperature of 60° at which it has passed the station-meter, but the soil in which the main-pipes are laid frequently reduces the temperature of the pipes, and of the gas passing through, below the normal temperature of 60°, so that the quantity will appear to be diminished, when, in fact, there has been no leakage. During the past severe winter, in the whole northern part of the United States, and, perhaps I may say, extending down well towards the southern, the continued cold weather caused the frost to penetrate so deep as to reach the gas-mains in most places, and at my own works a curious result was developed.

I was satisfied that there was an apparent loss in the month of February of about 3 per cent., to be traced directly to this cause. So great an increase of the unaccounted-for gas had never before appeared in the month of February. The month of March showed substantially the same result. Another cause of unaccounted-for gas is generally regarded by gas engineers as arising from condensation, but it is believed that where the gas is properly made there is very little or no condensation.

Unquestionably, where gas has been copiously washed with water, it is more or less saturated with watery vapour, which may, to a certain extent, increase the bulk as it passes through the station-meter; and, if afterwards it should be brought to a considerably lower temperature, such vapour may be condensed out of the gas, and, to a limited extent, the quantity will be decreased; but if the gas shall have been washed by gas liquor so called, it is not believed that any vapour will be carried forward in the gas which will be condensed out of it by colder temperature. The vapour of naphthaline is sometimes condensed out of the gas, causing the odour in the water pumped from the syphons or dips from time to time; but it is believed that this vapour is so small in quantity as not to have any appreciable effect upon the quantity of gas. Having found that the great bulk of unaccounted-for gas was caused by leakage in the mains and service-pipes, it becomes important to inquire how that leakage may be prevented. In the early manufacture of iron pipes for gas-mains, the iron put into them was so granular and porous that a large leakage was caused by the gas passing through the pores of the iron at all parts of the pipes. At the present date the quality of the iron used in casting mains has been very greatly improved; but even now it is believed that a very considerable amount of loss is caused by leakage through the pores of the iron, although the pipes are apparently sound; so that the main-pipes should be made of the best iron put into that class of work, and gas engineers should give preference in buying to pipes made from the best iron, even at a higher cost.

Of course every gas engineer knows that the mains should be well laid, well caulked with dry gas lime and lead or Portland cement; or, if conveniently obtained, old tarred rope, old junk, so-called, which will almost make a gas-tight joint of itself, if well driven home.

We all know that lead well packed makes a perfect joint. There may be some question about the use of Portland cement. In those parts of the country where the frost does not penetrate deep enough to reach the mains, and the ground on which the pipe is laid is solid, making a firm foundation for the mains, Portland cement undoubtedly makes a perfect joint; but in those portions of the country, where the frost reaches the pipes, the cement makes such a rigid unyielding joint, that the main-pipe will frequently break in another place before it will draw or yield at the point where the joint has been packed with cement, and it is recommended that if cement be used in the northern portion of the United States, that a lead joint should be made once in every 100 feet, so that the contraction of the main by the frost may draw at that joint, instead of causing the pipe to break in two, or drawing at the cement joints, which latter, if it take place, must inevitably make a leak, as the cement makes a rigid unyielding joint. In all cases where the ground is soft or liable to be disturbed by other causes, so as to cause a sinking of the main, lead should be used for the joint.

Every gas engineer knows that the tap for service-pipes should be drilled in perfectly round and true, so that the threads of the screw should bite in at least two of its circuits.

Having got the mains, made of good iron, into the ground, with the joints properly made with lead or cement well driven home, and the same properly tapped for service, if we find any considerable quantity of unaccounted-for gas we may safely conclude that there is leakage in the mains; and then comes the important question of how to find where it is.

The locality of the leakage may be approximately ascertained by districting the mains of the company, which is accomplished by the use of valves in the mains at the points necessary for that purpose.

Closing a valve and inserting a piece of service-pipe on each side of the valve into the main—these two pipes rising to or near the surface of the ground—then by placing a consumer's meter at the valve, and connecting the pipes so inserted into the mains with the meter by pieces of india-rubber tubing, the quantity of gas leakage in that district will pass through the meter, and so be easily and very accurately ascertained.

The writer tried this method upon about one mile of pipe, consisting of one half 6-inch and one half 4½-inch, where, at the time, it was believed there was considerable leakage, and was gratified to know that only 6 feet per hour passed through the consumer's meter, making a perfect demonstration that the leakage was not in that district, and soon afterwards it was found to be a broken pipe in another district.

Let me urge upon my brother gas managers the benefits to be derived from the plan of dividing off their gas territory into districts—there is much money saved by it.

These two pipes each side of the dip were left standing, and the district was tested several different times afterwards, and on different days, resulting with precisely the same quantity of 6 feet per hour passing through the consumer's meter. Thus it was rendered certain that no leakage of any larger magnitude than that existed in that district of pipe.

By this means an expenditure of money was saved, more than sufficient to pay for the valve and its insertion into the main. Besides, there is another benefit arising from this mode of proceeding. In case of fire in any one district, that district may be shut off, and all other parts of the territory may continue to be supplied in the ordinary way.

The desirableness of the district process was made most apparent in the City of Boston, at the time of the large fire there a few years ago, and I am informed that at present the Boston Gaslight Company has been at a very considerable expense to thoroughly district the whole territory occupied by the mains of that company; so that probably no city in the United States or Europe is as well provided for in these respects for the emergency of another fire, or to ascertain the leakage.

Having ascertained the district in which the leakage exists, so far as lies in the power of the engineer, the next thing is to find its special point in that district of main.

In two companies in which I am interested, the process of finding the point of leakage has uniformly been that of taking a light bar or piece of gas-pipe, with a sharpened steel point on the end, and holing down to or near the pipe once in every 6 feet. Once in 12 feet would probably discover a leak of any considerable magnitude, but for thorough work it should be once in 6 feet; and by this process a leak, which is so small that it cannot be lighted with a match, will surely be discovered.

Some may say that there is danger of breaking the main. My answer to that is—that in no instance in my experience has a single breakage occurred.

The same process used to discover the leakage of gas in the street-mains applies also to the finding of the leakage in the service-pipes.

As to the discovery of unaccounted-for gas used in the street-lamps, I know of no way to find that except by testing the burners with a proper burner-tester, under the same pressure as that which prevails at the point where the burner is used, or by a lamp-post meter, usually called "the average meter system."

Pressure is an element in the problem which increases or diminishes the quantity of unaccounted-for gas, and increases or diminishes the leakage, as the pressure is greater or less.

Following the same law, as far as leakage is concerned, as it does in the delivery of the gas through the mains—that is, four times the pressure doubles the quantity of the leakage, so that it becomes a matter of great interest to every gas company that their street-mains should be large in size, in proportion to the quantity of gas required to pass through them, in order that the proper quantity of gas may be passed and delivered to the consumer at a comparatively low pressure. The pressure is generally regulated at or near the works or holder, and sometimes at the point where the gas is passed to a district at a higher elevation, by some of the different forms of gas governors. When the gas is burned at a pressure of from 5-10ths to 8-10ths of an inch, it gives the consumer the greatest quantity of light for the amount of gas consumed; that being true economy for the consumer is also true economy for the gas company. The pressure being light, the leakage will be light also.

The main and service pipes both being large, the necessary quantity of gas will be easy to supply under that light pressure. The pressure through the day may be lighter than that of the burning hours in the early part of the night, and should be attended to by the person in charge so as to relieve the pipe from pressure, and consequently prevent loss by leakage.

I have thus indicated some of the more prominent points to be considered, and I come to what is a proper method of computation of the unaccounted-for gas.

The usual and almost universal way has been to reckon the same at a percentage upon the gross amount passed by the station-meter. This has always been unsatisfactory, as the quantity of gas made during the different months of the year varies so greatly; between the summer months and the winter months, the quantity passing the station-meter being nearly three times, and in some instances four times as great in the winter as in the summer, to supply the same consumers.

The leakage while passing through the same pipes should be no more in winter than in summur. Thus the per centage of leakage is a constantly varying per centage, as the quantity of gas made and consumed is a varying quantity.

The mode of computation used by myself has always been a reckoning of the unaccounted-for gas as found each month, at so much per mile of pipe per day. Then by comparing one month with another, it is easily ascertained whether the loss was in fact greater or less one month than in another, or in any other during the whole year.

We have here a certain and uniform basis of computation, unchanging from one part of the year to another, or from year to year; neither does the greater quantity of gas made in the winter or the lesser quantity in summer made any difference with it. Permit me to hope that this method, or some other equally certain and uniform, may be adopted by the whole gas world, for the computation of unaccounted-for gas.

I here give figures covering one year in time, in a company I am interested in, not as showing a wonderfully small unaccounted-for quantity of gas, but for the purpose of illustrating my method of computation. These figures are on a basis of 10 miles of pipe all brought to a standard of 4 inches diameter, and the quantity given is the number of feet per mile of 4-inch pipe per day:—

January	102
February	122
March	191
April	90
May	143
June	174
July	184
August	236
September	173
October	167
November	186
December	78

The gross amount of the loss ascertained from time to time, when the record of the consumers meters is taken, standing out prominently before the engineer in one total amount, immediately suggests the loss of so many dollars and cents, and thus each month he is reminded of the amount of his loss, while if the loss is computed by per centage in the winter months, the apparent gain by a less per centage gives a sort of ease at the idea of the apparent improvement, and leads to no active effort for its reduction. By computing it at so much per mile, a standard which is uniform, month by month and year by year, is provided. In working by this standard, if the loss is equal each month with the month before, the engineer is satisfied that the condition of his pipes remains the same, but if there is a greater loss it is shown to him at once, and he is admonished that it is necessary for him to act in the matter by way of its reduction.

If a comparison of the working of one company with another shall be desired, that is easily ascertained by bringing the number of miles of pipes of each company to one uniform standard of size by computation, say four or six inches; the circumference of every size of pipe being in fact the source from which leakage arises, so that in this respect a uniform standard is easily obtained. It is not claimed to be absolutely perfect, as the number of services on any given number of miles of pipe may vary, and to the extent that the service-pipes induce leakage that will be a variation; so also the working pressure may be different, but this can be calculated. If by presenting these suggestions I shall have brought to the mind of any gas engineer a new thought or suggestion, which enables him to reduce his unaccounted-for gas, and to that extent increase the credit side of his profit and loss account, I shall be amply compensated for the effort. I shall be happy to hear from members of the association their ideas on this subject.

A vote of thanks was unanimously tendered to Mr. Nettleton for his paper.

On the motion of Mr. M'NEAL, the secretary was authorized to make proper arrangements for the annual meeting of the association, in October.

The PRESIDENT suggested that the burning of tar as fuel was a topic which should receive further attention at the next meeting.

Mr. M'ILHENNY suggested the propriety of the president's appointing three gas engineers to read papers at each meeting. Unless some arbitrary rules were adopted, it would be difficult to keep up an interest in the meetings.

A MEMBER suggested that General Hickenlooper should prepare a paper on the subject of cooking by gas, to be read at the next meeting.

General HICKENLOOPER accepted the suggestion, and said he would prepare a paper on that subject.

By request of the president, Mr. BREESE agreed to prepare a paper on coal tar as a fuel.

On the motion of Mr. M'NEAL, the thanks of the association were tendered to the acting president (Mr. Price) for the very able and acceptable manner in which he had discharged the duties of presiding officer at this session.

Thanks were also voted to the publishers of the *American Gaslight Journal*, for their courtesy in reporting the proceedings of the association. The meeting then adjourned.

[Our report of the proceedings at these meetings has been condensed from the columns of our American contemporary.—ED. J. G. L.]

IRON AND COAL TRADES OF SHEFFIELD, SOUTH YORKSHIRE, AND NORTH DERBYSHIRE.

(FROM OUR OWN CORRESPONDENT.)

There has again been a well-sustained firmness in the local pig iron trade, a feeling doubtless very considerably influenced by the upward tendencies of the Scotch, Cleveland, and South Staffordshire markets. A moderately good pig of South Yorkshire or Derbyshire make is obtainable at 57s. 6d. to £3 2s. 6d. per ton. The quotations of the North Yorkshire makers agents are now as under:—No. 1 foundry, 57s. 6d.; No. 2 foundry, 54s. 6d.; No. 3 foundry, 52s. 6d.; No. 4 foundry, 48s. 6d.; No. 4 forge, grey, 47s. 6d.; No. 5 forge, mottled, 47s.; No. 6 forge, white, 46s. 6d.; refined metal, 70s.; Kentledge, 56s. to 56s. 6d.; and ordinary cinder pig, 40s. per ton. These prices have a stiffening tendency, the run being, however, mostly on the foundry numbers.

Ores are in fairly good request, those in general use hereabouts being obtained from the North Lincolnshire or Northamptonshire fields, although there are, at Renishaw, Thorncliffe, &c., a few local ironstone deposits not yet wholly worked out. The market for merchant iron is very quiet indeed, and prices are entirely unchanged, on the basis of £8 for common; £8 10s. to £9 for medium; and £9 to £10 for best bars of this description. The reduction in the price of Lowmoor iron has not had any appreciable effect on the market generally.

At the foundries a very encouraging amount of business is being transacted, with a sufficiency of inquiries to give satisfactory hopes for the immediate future. Water and gas pipes, colliery castings, and general builders castings are in most request, chiefly for the home markets. The Sheffield Water Company are now laying a 24-inch main from their recently completed Dam Flask reservoir to the Hillsborough, Wadsley, and Owlerton districts of the town.

The Leeds machinery and engineering trades, as well as the tool-making industries, are reported to be dull and quiet. At the Elsecar iron-works of Messrs. Dawes a series of experiments have been instituted in iron-making, the results of which are looked forward to with a considerable amount of curiosity. No alteration in the prices of coal or coke has been made this month, although the demand for many kinds of fuel is very dull, owing to the season and the depression of the iron and steel trades.

The coalowners met at Sheffield last week, under the chairmanship of Mr. Robert Baxter, and, after a long deliberation, decided to abandon their proposal to reduce the wages of the whole of the miners by 10 per cent. The men naturally hail this determination as a sign of weakness on the part of the employers, and assert that the profits of coal-working are by no means so meagre as the coalowners represent them to be. Quotations are as last week.

IRON AND COAL TRADES OF SOUTH STAFFORDSHIRE AND EAST WORCESTERSHIRE.

(FROM OUR OWN CORRESPONDENT.)

The resolution passed last week by the leading representatives of the finished iron trade, with respect to puddlers wages, did not fully answer the desired end; on the contrary, the millmen, who were not included in the arrangement, at once assumed a more defiant attitude, and expressed their determination to resist the adoption of the proposed new scale; consequently, a second meeting of the committee was held in the Chamber of Commerce, Birmingham, on Thursday last, under the presidency of Mr. Hunt, of the New British Iron Company, when the subject at issue was discussed at length, and the following resolution was ultimately passed—viz., "That pending the reconstruction of the board of conciliation, upon which in the future it is desirable that millmen should be more fully represented, this committee recommends that from the 23rd of August last the rate of wages paid to millmen be on the same scale as at last settlement." Should the resolution be generally adopted, there is little doubt the operatives will quietly return to work, and we shall hear no more of the wages difficulty for the present, especially as it is generally admitted that this concession offered by the ironmasters is not justified by the general condition of the trade, and the existing circumstances of production.

The course of business during the past week has naturally been very irregular and unsettled. Though the orders actually placed are of small extent, some difficulty is experienced in obtaining supplies of iron of the medium and common qualities, and prices for these descriptions are therefore somewhat stiffer; indeed, in some instances a small premium has been offered for prompt deliveries.

Sheets, hoops, and plates continue in leading demand. Galvanized roofing-sheets are quoted £18 10s. per ton for 20 gauge f.o.b.; unmarked bars are steady at £7 15s. per ton, and other descriptions of merchant iron in the usual proportion to that basis.

The pig iron makers complain of the continued severity of the competition to which they are subject on the part of the producers in the northern districts, whose iron is coming into South Staffordshire in considerable quantities, and at very low rates. The number of furnaces blowing this week is 70, being one less than reported a week ago. Common cinder pigs are quoted at £2 15s. per ton, but they have been dealt in at £2 12s. 6d. Best native all-mine pigs are steady at £4 10s. for hot-air, and £5 for cold-air makes.

The coal market is without important change, either as to demand or selling rates; best qualities of fuel are in improving inquiry, both for household and manufacturing purposes.

The wrought tube and fitting trades at Wednesbury are somewhat more active, and prospects for these industries are brighter than they have been for some time past.

THE COAL AND IRON TRADES OF LANCASHIRE.

(FROM OUR OWN CORRESPONDENT.)

The steadier tone in the coal trade of this district, noticed in my last report, continues, and prices generally are maintained. There are, however, a good many inquiries in the market, and a healthy trade is looked forward to before long. For the better classes of coal there is a tolerably fair demand, but the common sorts are still a drug, and, in some cases, a little easier. Slack is not quite so scarce as it has been, but for this description of fuel there is a pretty good demand from brickmakers, whose season is now approaching its close.

The shipping trade is still very dull, and, with the exception of a few special qualities of coal, supplies are very plentiful in the Liverpool market. Stocks in Lancashire are not generally heavy, but this is due to the short time which has been generally adopted at the collieries throughout the summer; as, with the depressed state of trade which has prevailed, anything approaching the full average get would have caused a very large accumulation of coal on the pit banks.

The gas coal trade continues dull, and there are at present very few inquiries in the market.

The coke trade also remains in a depressed state, and prices are weak.

At two of the large collieries in the Wigan district there has been a strike during the past week, in consequence of a reduction in wages. In November last, when a reduction of 10 per cent. was agreed upon by the West Lancashire Coal Association, Messrs. Blundell and Son declined to be bound by the action of the association, and, when the general strike took place, their men continued at work on the old rate of wages. The continued decline in the price of coal which has since taken place has, however, now compelled Messrs. Blundell to reduce the wages of their men 10 per cent. Against this the men have struck. As, however, their wages are only being brought to the level of those now being paid at other collieries, it is not probable that the turn-out will be of long duration, and already some of the men have returned to work. The strike affects about 800 men and boys.

The iron market of this district continues very flat, and, notwithstanding

improved prices for foundry pig iron, there is very little doing, founders thinking the higher prices are only temporary, and will soon recede when the shipping season has closed. No. 3 Middlesbrough foundry pig iron, for immediate delivery in this district, is quoted at 61s. 3d. per ton; No. 4 foundry, 57s. 6d.; No. 4 forge, 56s. 9d.; mottled, 53s. 6d.; and white, 54s. 9d. per ton. For delivery over a few months, merchants are disposed to take a little less for foundry qualities. In finished iron there is nothing doing, and prices are weak. In rails 2s. 6d. under list prices is being accepted for good specifications. Nominally the rates are £7 4s. for heavy rails, and £7 14s. for light rails, delivered in this district.

The engineering trade continues in an unsettled state, and some of the men in the Bolton district have turned out against a reduction in wages.

THE COAL AND GENERAL TRADE OF THE NORTH OF ENGLAND.

(FROM OUR OWN CORRESPONDENT.)

The South Durham coalowners have reduced the price of households 1s. 6d. per ton officially. It is stated that this is preliminary to asking the workmen to submit to a further fall of wages. A very good quality of gas coals was sold last week at 9s. 6d. per ton, less 5 per cent. discount; inferior is below that price; and it may be stated that second-class gas coals are plentiful in the market. The local demand for all classes of coal is poor. This continues to cause many of the collieries to send coals on consignment direct to the foreign ports, which explains the anomaly of complaints of bad business with shipments more than last year. The pits are not working very well, and it is quite probable that there will be a reduction in the price of steam coals after the 1st of October.

There was a moderate arrival of vessels in the Tyne and Wear last week, but more coasters were to hand. Coasting orders were in the market. As coals are now wanted to make up stocks at most of the bye-ports, ships were taken up pretty freely at a slight advance of rates. Foreign business, however, was not at all active. There was a specially dull business to the Mediterranean, and it is very probable that there will be an extremely poor trade for steamers during the whole of the autumn.

The Cleveland iron trade has improved somewhat in tone. There has been a slight advance upon recent quotations; but it is hardly likely that any great rise in iron will be established this year. At any rate this is the opinion of the most competent men in the trade.

Last week there were considerable sales of soda in the chemical market of the Tyne, and the trade generally is slightly firmer. The fire-clay and fire-brick trade of the North of England is exceptionally busy. Shipments are being made to most parts of the Continent, and a demand has sprung up for Spain, where some new smelting works have been commenced. In other respects the general manufacturing trade of the Tyne is unchanged.

TRADE NOTES FROM SCOTLAND.

(FROM OUR OWN CORRESPONDENT)

The directors of the Biggar Gas Company have resolved to reduce the price of gas from 9s. 2d. to 7s. 6d. per 1000 cubic feet, the change to take place as at the 31st of August last. It has finally been resolved to reduce the price of gas at Kilmarnock from 5s. 10d. to 5s. per 1000 cubic feet.

The gas question is now forming a prominent subject of discussion and public interest amongst the Glasgow ratepayers. It was again up for consideration at an adjourned meeting of the Town Council, sitting as the Gas Corporation, on Thursday, one of the points in dispute being the proposal to give up the long established practice of granting discounts to large consumers.

It may be mentioned that there is not likely to be any attempt made to erect new gas-works by the ratepayers or Town Council of Kirkcaldy, and therefore the supply is likely to continue for some time longer in the hands of the North British Railway Company. The clamour that was recently raised, however, in consequence of the railway company resolving to uphold the high price of gas, has had some effect, inasmuch as the price is now actually to be reduced from 7s. 6d. to 6s. 8d. per 1000 cubic feet, as from the 31st of July last. But the ratepayers have not become entirely mollified by that resolution, for in their memorial to the Town Council they say that the tendency of recent legislation is to facilitate the acquisition, and secure the proper management of such gas-works by corporations, and that there is every likelihood of Sir Windham Anstruther's bill, or another to the same effect, being passed into law next session, whereby not only borrowing and other important powers will be conferred on corporations, but ample securities afforded for the purity, cheapness, and proper distribution of gas.

Carluke, an important town in the Upper Ward of Lanarkshire, is busying itself with a new water scheme. It is proposed to go to Badshaw as the source of the supply. Mr. Tait, civil engineer, Wishaw, is working out the scheme.

Motherwell, which is a still more important town, but in the Middle Ward, is quite in the "throes" of a water agitation. Within the burgh boundary alone there are well-nigh 10,000 of a population, and a good supply has become quite a necessity. A scheme has been projected which is likely, if carried out, to cost £15,000 or £18,000. It should rather be said that two schemes have been projected, and that Mr. Leslie, C.E., Edinburgh, or Mr. Gale, C.E., Glasgow, may have to decide upon their respective merits.

The Police Commissioners of Grangemouth have now got far advanced with a water supply scheme. Their No. 2 contract has been signed. It embraces the laying of main-pipes between the projected water reservoir at Millhall and Grangemouth, the contractor being Mr. Kenneth Mackenzie. The plans for the entire work have been prepared by Messrs. R. B. Bell and Millar, civil engineers, Glasgow, and operations are being vigorously pushed forward.

An important step is being taken by the Edinburgh and District Water Trustees in connexion with their new Moorfoot Water-Works scheme. They are about to commence digging and refilling about 8¼ miles of pipe track from Edgelaw to Alnwickhill, and laying and jointing cast-iron pipes therein, 22 and 24 inches diameter, and the execution of the accompanying works, which include a tunnel, 420 yards long, and several bridges.

During last quarter the water-fittings inspectors in the service of the Glasgow Corporation Water Committee visited upwards of 116,000 taps, and found 12,400 of them in bad repair, or 1 in every 9·4. They also made 2200 visits in connexion with complaints lodged at the engineer's office, and served 4775 notices to have repairs executed. It is very probable that ere long there will be legal proceedings instituted against some of the water consumers who are found to be wilfully wasting the water. Reporting to the committee on works on the 30th ult., the engineer said that the quantity of water in store was as follows:—In the lochs, 112 days supply; in Mugdock reservoir, 16 days supply; in Gorbals reservoir, 56 days supply; and that the quantity of water sent into the city and suburbs during the previous fortnight averaged 35,200,000 gallons per day.

With reference to the new water supply from Lintrathen for Dundee, it may be mentioned that Mr. Stewart, the engineer, has written to the Water Commissioners to say that he thinks it will be possible to make the test of the pipes required by the commissioners on Monday, the 13th inst.

The town of Ayr is in a dissatisfied condition in reference to the short supply of water which the "powers that be" have recently vouchsafed to grant to the consumers. Dissatisfaction is also being expressed by the burgh commissioners and people of Cupar generally at the slow progress which the new water-works for that town are making.

Prices of pig iron have not changed much since last report. On Wednesday 1500 tons changed hands at 63s. 9d., one month fixed; 500 tons at 63s. 10d., 16 days fixed; and 500 tons at 64s. cash; market closing buyers, 64s.; sellers, 64s. 1½d cash. Business has since been done at 64s. 6d., one month open. The stock of warrants in the public stores has now reached to about 56,000 tons.

No alteration of any importance in the price of coal has taken place, but some varieties are in somewhat better demand.

JAMAICA WATER-WORKS.—One of the most important works being carried out in Jamaica is the construction of new water-works for the improvement of the water supply of the city of Kingston. In the carrying out of these works a dam across the Hope river has been constructed, for the purpose of increasing the quantity of water flowing into the culvert. Two reservoirs, at the termination of the culvert near the city, are in course of construction. They will contain five million gallons of water. Two filter-beds have also been constructed. From the reservoirs the water will flow into the city and its suburbs by a system of iron pipes. The main pipe is 21 inches in diameter.—*The Builder*.

REPORTED EXPLOSION OF GAS ON SHIPBOARD.—The Tyne steamer, *Martin Wiener*, owned by Sir George Elliot and partners, sailed from the Tyne with gas coals on the 31th of August for Hamburg, and has not since been heard of. A lifeboat, bearing the name *Martin Wiener*, has been picked up bottom up, on Dogger Bank, and landed at Amble. It is feared that the vessel has been blown up with gas, although special arrangements were made to secure proper ventilation. The crew consisted of 19 hands. Hopes are entertained that they have succeeded in getting on board some vessel bound for the Baltic.

DAYLIGHT SUPERSEDED.—A local paper states that on the introduction of gas into Slaithwaite, many of the inhabitants had never seen a brighter artificial light than was emitted from oil lamps and farthing candles. Consequently they came from the hill sides to look at what they termed the "New-fangled invention," which at the same time gratified their curiosity and dazzled their eyesight. Amongst the rest was a lad from Scammonden way, who had left his bobbin wheel to gaze on the extraordinary spectacle which had all at once so much enlightened the land of his nativity. He uttered never a word, but stared with eyes opened wide, and mouth still wider. After thus standing in bewilderment for a considerable length of time, he scampered off home as fast as his legs could carry him. Arrived at his father's domicile, he exclaimed, "Eh, father! Yond licks dolly! It comes up a dreyn i'small paiopes wi' a tap at th'end, un when tap's turned ther' comes a blaze yat as big as a cream piece. 'Tha should see for thiseln, tha'd be cappe'd wi't. It beats conjerin. Yond's far afoore dayleet."

GLASGOW WATER SUPPLY.—At the monthly meeting of the Glasgow Corporation Water Committee on the 6th inst., it was reported by Mr. Gale, the engineer, that during the past quarter the water-fittings inspectors had visited upwards of 116,000 taps, and found 12,400 of them in bad repair, or 1 in every 9·4. They had also made 2200 visits in connexion with complaints lodged at this office, and had served 4775 notices to have repairs executed. There were now three district meters at work, but, as far as the observations had gone, the repairs which had been made upon the water fittings did not appear to be of such a permanent kind as could be desired. It having been reported to the sub-committee that waste of water had been caused in two instances by the taps of closets being left running, it was resolved to prosecute parties so offending in future, and Mr. Gale was instructed to exercise the powers conferred by the Act, and to see that regulation fittings were introduced wherever water was found to be wasted. It was reported to the committee also that the assessor had valued the water-works undertaking at £106,655 13s. 5d., being an increase on last year of about £25,000. This increase arose in consequence of the assessor not allowing anything for what were called tenants profits, acting on the precedent established by a case decided in England in reference to the Mersey Docks. He applied the same principle to the gas-works last year, and on the case being brought before the Lord Ordinary, the only court of appeal, he affirmed the valuation. After some consideration the committee resolved upon lodging an appeal.

GLASGOW GAS SUPPLY.—A meeting of the Glasgow Town Council was held last Thursday, for the purpose of disposing of the business left over from the previous week. The meeting took up the report and the minutes of the Gas Committee, which were partially discussed at last council, Mr. Walls then moving their approval, including as they did two proposals—first, that in future no discounts be allowed to large consumers of gas; and secondly, that the valuation which Mr. Dods, the assessor of railways and canals, proposed to put on the undertaking for the present year (being £98,991, or about £38,000 in excess of last year) should be appealed against. At that meeting Bailie Collins moved as an amendment that the proposal to discontinue discounts to large consumers should not be agreed to. On the discussion being resumed. Mr. Mathieson opposed the proposal of the committee to appeal against the valuation as he thought it was not seemly that the corporation should get into litigation with parochial boards, which would be the effect of contesting the valuation. He moved, as an amendment, that the recommendation of the committee be not agreed to. Mr. Thomson seconded the amendment. Mr. Wilson thought it would just be a needless waste of the public money to attempt to overturn Mr. Dods's valuation. Even though they were charged a little more, it was just putting money out of one pocket into another. "The poor ye have always with you;" gas they could perhaps do without. Mr. Scott seconded Bailie Collins's amendment in favour of the continuance of gas discounts as formerly. Mr. Marwick having spoken with reference to the legal considerations applying to the question of appealing against Mr. Dods's valuation, his general contention was favourable to the prosecution of the appeal. The council, divided and Bailie Collins's amendment was carried by the casting vote of the chairman, while the motion to appeal was agreed to by 20 votes to 5.

D. BRUCE PEEBLES & CO.,
ENGINEERS,
FOUNTAINBRIDGE WORKS, EDINBURGH,
MANUFACTURERS OF WET AND DRY GAS-METERS;
Patentees and Sole Manufacturers of PEEBLES' LAMP-GOVERNORS,
ABOVE 30,000 OF WHICH ARE NOW IN USE.
"These Lamp-Governors are so superior that they are likely to supplant all others."—*Dr. Wm. Wallace, F.R.S., F.C.S.*
D. BRUCE PEEBLES AND CO., FOUNTAINBRIDGE WORKS, EDINBURGH.

The GRAND MEDAL of MERIT at the VIENNA EXHIBITION has been AWARDED to

GWYNNE & BEALE'S PATENT IMPROVED GAS-EXHAUSTERS,

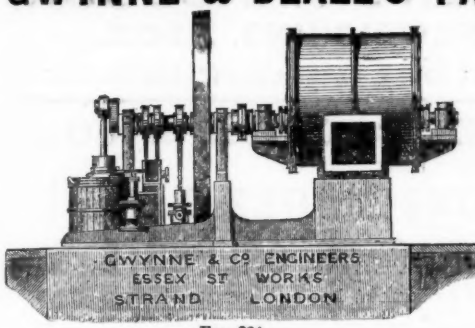


FIG. 224.

The BEST EXHAUSTERS IN THE WORLD.

Made under the personal superintendence of

Mr. BEALE,

The oldest Maker, Inventor and Patentee of

GAS-EXHAUSTING MACHINERY.

(It is NOT CORRECT to state that Mr. BEALE has RETIRED.)

Prices and every information on application.

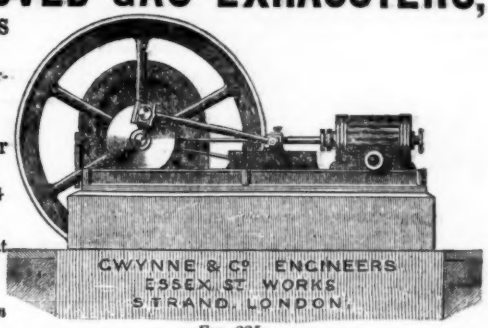


FIG. 225.

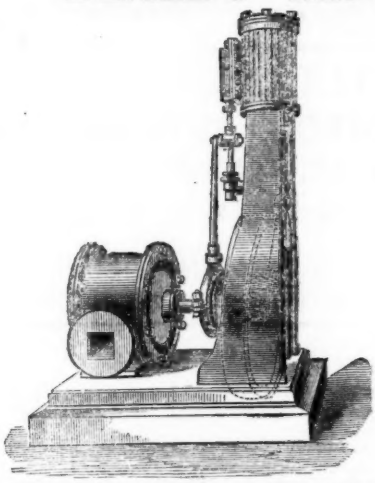
Fig. 224 represents one of those erected at the Imperial Gas-Works, Bromley, capable of passing 210,000 cubic feet of gas per hour. Several others of the same size are now on order for the same Company. These Patent Machines combine the highest quality of workmanship and materials, the largest bearings and wearing surfaces, with the **most perfect system of action yet discovered.** Fig. 225 represents one of a series of four at the Nottingham Gas-Works, each passing 52,500 cubic feet per hour. GWYNNE AND Co. *do not pretend to enter into a struggle with other makers in respect to cheapness. They have never sought to make price the chief consideration, but to produce Machinery of the very highest quality, and the most approved design and arrangement.* Their prices have been estimated with a due regard to the **excellence of the article produced,** and when this is taken into consideration, they have no fear for the result. The orders executed this season for Exhausters and alterations to their patented system amount to over 4,000,000 cubic feet of gas passed per hour, and to over 300 horse power for Engines to drive them. In every instance their work is giving the greatest satisfaction. Numerous testimonials and references can be given.

REGULATORS, BYE-PASSES, STOP-VALVES, GAS-VALVES, & MACHINERY FOR GAS MANUFACTURE, OF ALL SIZES, CAN BE HAD ON APPLICATION TO

GWYNNE & CO., HYDRAULIC & GAS ENGINEERS, ESSEX STREET WORKS, STRAND, LONDON, W.C.

G. & Co. are now manufacturing for a London Gas Company three of their 210,000 cubic feet Patent Gas Exhausters, and many of all sizes.

BEALE'S IMPROVED PATENT GAS-EXHAUSTER



WITH

ENGINE COMBINED

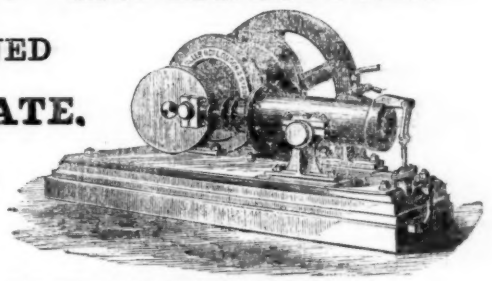
ON

ONE BASE PLATE.

SOLE MAKERS,

GEORGE WALLER & CO.,

Who, since Mr. BEALE'S retirement, are the Oldest Makers.



EXHAUSTERS with HORIZONTAL ENGINE combined.
EXHAUSTERS with OUTSIDE BEARINGS.
MAKERS of ENGINES, BOILERS, and GAS MACHINERY.
TAR, LIQUOR, and SYPHON PUMPS. GAS-VALVES in stock, 2 to 30 inches.
SELF-ACTING BYE-PASS VALVES, with Lid and Relieving Lever.
MANN'S and many other descriptions of WATER DISTRIBUTORS.
SCRUBBERS, PURIFIERS, and CONDENSERS.
EXHAUSTERS from 3000 to 60,000, new and second hand, in stock.

PHŒNIX ENGINEERING WORKS, HOLLAND STREET, S.E., & at STROUD, GLOUCESTERSHIRE.

WANTED, a situation as Improver in a Gas-Work, under a blacksmith and main and service layer, by a young Man, the son of a Manager.
Address MANAGER, Gas-Works, BASINGSTOKE.

GAS PURIFIERS.

WANTED, four second-hand Purifiers, about 8 ft. square, in good condition.
Address THOMAS GLOVER AND Co., 214, St. John Street, LONDON.

WANTED immediately, at a Gas-Work in the country, a steady and industrious Man as STOKER. Constant employment. Average wages 26s. per week.
Apply to the SECRETARY, Gas Office, Winsford, CHESHIRE

WANTED, by a thoroughly practical Manager, a similar SITUATION, where the make of gas is not less than 16 millions. Has held the last situation 20 years. First-class testimonials and references.
Address No. 195, care of Mr. King, 11, Bolt Court, FLEET STREET, E.C.

WANTED, the Management of a Gas- Work, where a day stoker is kept preferred. Understands engine and exhauster, laying mains, services, and fixing meters, &c.; or as an Assistant Manager of a large Gas-Work.
Address No. 191, care of Mr. King, 11, Bolt Court, FLEET STREET, E.C.

WANTED, by the Advertiser, a situa- tion as MANAGER and Collector of small, or Assistant Manager of larger, Gas-Works. Well acquainted with manufacture of gas, laying mains and services, and taking meters, and is a first-rate collector of accounts.
Address E. H., care of Mr. Harris, 10, LAURENCE POUNTNEY LANE, E.C.

WANTED, at a provincial Gas-Work, a handy man to act as NIGHT FOREMAN during the winter. Must make himself generally useful for the remainder of the year. Make 120 millions per annum.
Apply, by letter, stating age, wages required, present occupation, and reference, to No. 196, care of Mr. King, 11, Bolt Court, FLEET STREET, E.C.

WANTED, for a Gas-Work near London, a steady Man as STOKER. Constant employment. Must understand the working of an Exhauster and clay retorts. Liberal wages.
Apply, by letter, to No. 194, care of Mr. King, 11, Bolt Court, FLEET STREET, E.C.

WANTED, by the Gravesend and Milton Gas Company, Kent, a BRICKLAYER as a Retort Setter, and for the general repairs of a Gas-Work. To a steady and good workman the situation will be permanent.
Address, stating wages required, and references, to Mr. MARVIN, Gravesend and Milton Gas Company, Canal Basin, GRAVESEND.

ASSISTANT ENGINEER.

WANTED, in a provincial Gas-Work, the services of a gentleman as ASSISTANT ENGINEER. He must be a good draughtsman, and well acquainted with the modern principles of making and purifying gas. Salary £200 per annum.
Apply, by letter, to 192, care of Mr. King, 11, Bolt Court, FLEET STREET, E.C., on or before the 20th proximo.
Aug. 24, 1875.

CHEPSTOW GAS & COKE CONSUMERS COMPANY.

WANTED, a Secretary and Manager, who thoroughly and practically understands the manufacture, distribution, and testing of gas, the setting of retorts, and all the other duties appertaining to the office. He will be required to devote the whole of his time to his duties. Annual make about 9 millions. Salary £90 per year. Security will be required for £200.
Applications, accompanied by not more than six recent testimonials, to be sent, addressed to the Chairman of the Gas Company, Bank Buildings, Chepstow, on or before the 25th day of September, 1875.
HENRY BOULTON, Secretary and Manager.

THE St. Day Fire-Brick and China Clay Company, Limited, having largely increased their works, are now prepared to TENDER in any quantity for the supply of their well-known BRICKS and other FIRE GOODS, either for the Home trade or exportation. Prices and samples will be forwarded on application to the works, St. Day, CORNWALL, or the London Offices, 7, St. Bene't Place, GRACECHURCH STREET.

NEW EDITION, NOW READY,

ADVANTAGES OF GAS FOR

COOKING AND HEATING.

By MAGNUS OHREN, A.I.C.E., F.C.S.

For Companies to issue to their Gas Consumers.

Specimen Copy by post Threepence, direct from MAGNUS OHREN, Gas-Works Lower Sydenham, London, S.E.

THE Llanelly Gaslight Company desire to secure the services of an experienced practical MANAGER, accustomed to the manufacture and distribution of gas. Present make 17 millions, rapidly increasing.
Apply, stating salary required, to Mr. JOHN POWELL, Secretary, Llanelly, SOUTH WALES.

TO IRONFOUNDERS.

THE Rochdale Corporation invite TENDERS for Twelve straight 6 ft. PIPES, 4 ft. diameter, and one Bend 4 ft. diameter.
Any further information may be obtained from the Borough Surveyor, Town-Hall, Rochdale.
Tenders, endorsed "Tender for Pipes," to be sent to me on or before the 21st of September inst.
By order,
ZACH. MELLOR, Town-Clerk.
Town-Hall, Rochdale, Sept. 10, 1875.

TENDER FOR TAR.

THE Directors of the Exeter Gaslight and Coke Company are prepared to receive TENDERS from parties willing to purchase such TAR as the Company may desire to dispose of for Three years from the 1st of October, 1875.
The Directors do not bind themselves to accept the highest or any tender.
Sealed tenders, endorsed "Tender for Tar," to be sent to me, the undersigned, on or before Monday, the 20th inst.
W. A. PADFIELD, Secretary.
Gas-Works, Exeter, Sept. 4, 1875.

G. A. BAILEY AND CO., Machinists, Manufacturers of all kinds of Indexes for Gas and Water Meters, Indicators, Tell-Tales for Turnstiles, on an improved principle. Every description of Wheel and Worm Cutting, &c.
86, Crampton Street, Newington Butts, LONDON, S.E.
N.B.—Country Orders executed with despatch.

SOUTH METROPOLITAN GASLIGHT AND COKE COMPANY.

NOTICE is hereby given that the ORDINARY HALF-YEARLY GENERAL MEETING of this Company will be held at the London Tavern, Bishopsgate Street, in the City of London, on MONDAY, the 4th day of October next, at Two o'clock in the afternoon precisely, to receive the Report of the Directors and the Accounts of the Company for the half year ended the 30th of June last, and to declare a Dividend for the same period.

By order of the Board,
GEORGE LIVESEY, Secretary and Engineer.

589, Old Kent Road, S.E., Sept. 13, 1875.

The Transfer Books of the Company will be closed from the 20th of September to the 4th of October.

THE WEST KENT GAS COMPANY.

OFFICES, 237, SOUTHWARK BRIDGE ROAD,
LONDON, Sept. 6, 1875.

The ORDINARY GENERAL MEETING of the SHAREHOLDERS of this Company will be held at the Offices, as above, on MONDAY, the 27th inst., at Three o'clock in the afternoon, precisely, for the purpose of receiving the Directors Report, and a Statement of the Company's Accounts, made up to June 30, 1875, to declare a Dividend thereon, and to sanction an increase of the Secretary's salary.

After the Ordinary General Meeting, the meeting will be made special and extraordinary, to confirm the minutes of the Extraordinary Meeting held on the 31st of March, 1875.

The Transfer Books will be closed from the 14th to the 28th of September.

By order of the Board,
ROBT. P. KEYS, Secretary.

WIDNES GAS-WORKS.

THE Gas Committee are prepared to

receive TENDERS for the supply of about 7500 tons of GAS COAL, to be delivered at their works in such quantities and times as may be required during the 12 months commencing Nov. 1, 1875.

Conditions and forms of tender may be obtained from the undersigned.

Tenders to be addressed to the Chairman of the Gas and Water Committee, endorsed "Tender for Gas Coal," and delivered at the Public Offices, Widnes, not later than 10 a.m. upon the 24th inst.

The Committee do not bind themselves to accept the lowest or any tender.

HENRY ROBERTS.

Widnes, Sept. 9, 1875.

BOROUGH OF BARROW-IN-FURNESS—GAS AND WATER DEPARTMENT.

CONTRACT FOR SUPPLY OF GAS COAL, &c.

THE Gas and Water Committee invite

TENDERS for the supply of about 6000 tons of GAS COAL and 3000 tons of CANNEL, to be delivered at their works in such quantities and at such stated periods as may be required during the 12 months ending the 31st of December, 1876.

Particulars and conditions of contract may be obtained on application to the Town-Clerk.

Sealed tenders, addressed "The Chairman of the Gas and Water Committee," and endorsed, to be sent in to me not later than the 27th of September, 1875.

The lowest or any tender not necessarily accepted.

By order,
C. F. PRESTON, Town-Clerk.

Municipal Offices, Sept. 3, 1875.

T. NEWBIGGING,

CONSULTING GAS ENGINEER,
ECCLES, MANCHESTER.

D. M. NELSON,

48, GORDON STREET (late 135, BUCHANAN ST.),
GLASGOW,

Supplies every requisite in connexion with the distribution of Gas and Water.

Estimates and prices on application.

WOOD GRIDS for Purifiers and Scrubbers.
Cast-Iron PIPES and VALVES.
Street LAMP-PILLARS.
Patent Pipe SCREWING-MACHINES, &c.

Mr. ALFRED LASS,

60, CORNHILL, LONDON, E.C.,

Is prepared to open the Books, and, if necessary, keep the Accounts of Gas and Water Companies.

To examine the Books and Accounts, and prepare Balance-Sheets for the information of Directors.

To assist Secretaries in preparing Balance-Sheets, according to the "Gas-Works Clauses Act, 1871;" or may be consulted with respect to Accounts generally.

FRASER'S PATENT RIBBED RETORTS

Are in use at over 200 Gas-Works, and give entire satisfaction.

Gas-Works, Beaconsfield, June 14, 1875.

Dear Sir,—The Patent Ribbed Iron Retorts you supplied the above Company have now been for four years in working, and have stood well, fully justifying their superiority over ordinary iron retorts.

They have given our Directors every satisfaction.

I am, yours truly,
(Signed) CHAS. ELDRIDGE.

To A. C. Fraser, Esq., St. Stephen's Chambers,
Telegraph Street, London, E.C.

CLOTH GAS-BAGS FOR MAINS.

As supplied to the Imperial, Chartered, and other London and Provincial Gas Companies. Bellows and Valves for inflating Well Dresses, Stokers Gloves, India-Rubber Suction and Delivery Hose, Gas-Tubing, Leather, India-Rubber and Gutta-Percha Machine-Bands, Sheet and Washers and Steam Joints.

T. BUGDEN, Manufacturer,
79, GOSWELL ROAD, LONDON, E.C.

Now ready, Second Edition, price 7s., by post 7s. 3d.,
THE
GAS MANAGER'S HANDBOOK.
By THOMAS NEWBIGGING, A.I.C.E.

WILLIAM B. KING, 11, BOLT COURT, FLEET STREET, LONDON, E.C.

MESSRS. JOHN BETHELL & CO.,

(ESTABLISHED 1836,)

CONTRACTORS for GAS TAR,

MAKERS OF ANTHRACENE, CREOSOTE, &c.,

CLAYTON CHEMICAL WORKS, MANCHESTER;
SWAN VILLAGE, WEST BROMWICH.

Head Offices: 38, KING WILLIAM STREET, LONDON BRIDGE.

JOHN HALL AND CO., STOURBRIDGE,

Manufacturers of FIRE-BRICKS, LUMPS, TILES,

AND EVERY DESCRIPTION OF FIRE-CLAY GOODS.

N.B.—A Stock of 15 and 16 in. CIRCULAR RETORTS always on hand. Other kinds made to order on short Notice.

ALFRED WILLIAMS,

PHŒNIX FIRE-BRICK WHARF,

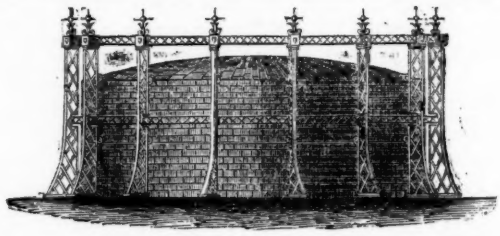
64, BANKSIDE, SOUTHWARK, LONDON, S.E.

GAS ENGINEER AND CONTRACTOR FOR THE ERECTION OF GAS-WORKS,
AND FOR THE
SUPPLY OF RETORTS, FIRE-BRICKS, CAST-IRON MAINS,
AND ALL MATERIALS FOR GAS MANUFACTURE AND DISTRIBUTION.

GEORGE ORME & CO.,

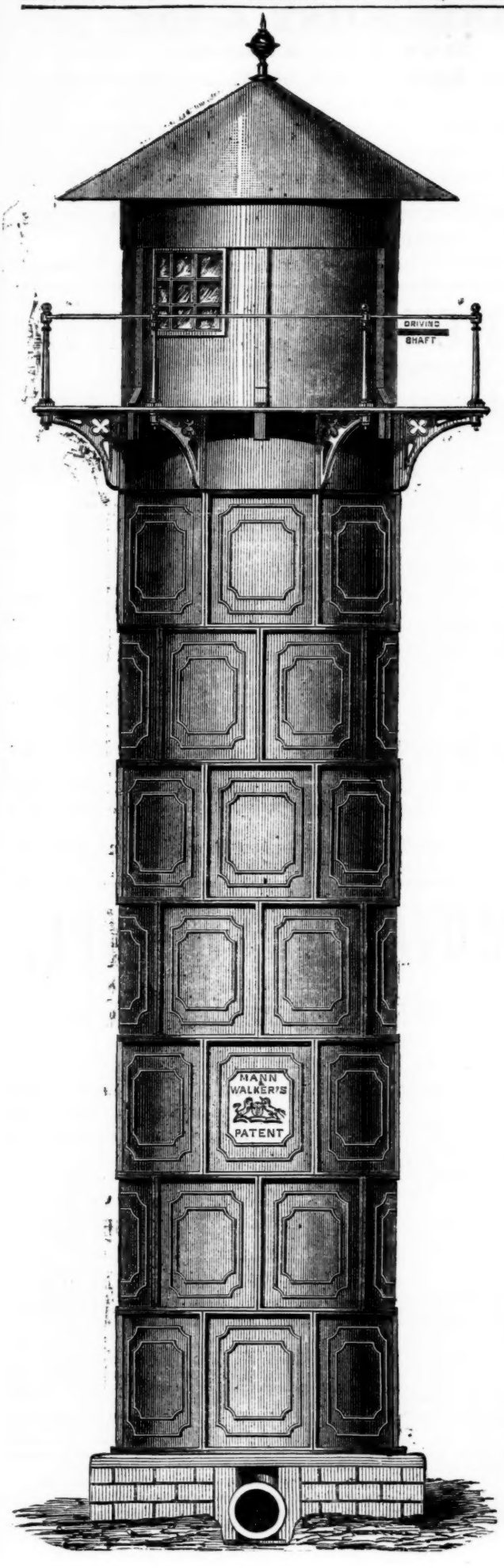
GAS METER MANUFACTURERS, BRASSFOUNDERS & FINISHERS,
ATLAS METER-WORKS, OLDHAM.

CONSUMERS WET & DRY GAS-METERS ON THE MOST APPROVED PRINCIPLES.
STATION-METERS, GOVERNORS, PRESSURE-REGISTERS,
And every Description of Gas Apparatus.
GAS, STEAM, AND WATER FITTINGS.



THE HORSELEY COMPANY,

LIMITED,
TIPTON, STAFFORDSHIRE.
LONDON OFFICE:
6, WESTMINSTER CHAMBERS, VICTORIA STREET,
GAS ENGINEERS, IRONFOUNDERS, &c.,
MANUFACTURERS OF
GASHOLDERS, WROUGHT AND CAST IRON TANKS, CONDENSERS, PURIFIERS, SCRUBBERS, MAINS, RETORT-LIDS, PLAIN AND DISHED, LAMP-POSTS, PIPES,
AND ALL REQUISITES FOR EITHER
GAS OR WATER WORKS;
ALSO
MAKERS OF ROOFS, BRIDGES, &c.



C. & W. WALKER,
8, FINSBURY CIRCUS,
LONDON, E.C.

MANN & WALKERS' PATENT SCRUBBER.

By Letters Patent in Great Britain, Europe, and the United States of America.

The improvements made during the past three or four years in all the parts of the internal and external construction and machinery of these Scrubbers have rendered them perfect for their work of purification with all kinds of coal, and their cost is less than any other method of completely purifying gas from ammonia.

They contain their own motive power, requiring only a small inappreciable quantity of steam from the gas-works boiler, and are then complete in themselves, ready for service.

They are, in all cases, constructed under guarantees to perfectly perform their work. They are now extensively used in the largest gas-works of London and the chief cities of Europe, **nearly one hundred being in use,** and their perfect efficiency and profit to a gas company have been fully established with every variety of coal used in Europe. References can be given to the largest gas-works in Europe.

By their use the department of purification from ammonia upon a gas-works is made complete, without the aid of prepared oxide of iron, chemicals in purifiers, or any other supplementary process, and the whole ammoniacal residual product contained in the coal is absorbed and obtained in the form most profitable to a gas company, while the requirements of all Acts of Parliament and of the Board of Trade, relating to incorporate gas companies, are satisfied.

Foul Gas, properly condensed, entering the inlet is, by once only passing through the Scrubber, completely purified from ammonia with regular certainty day by day, without any further trouble, or any other process, effected by a very small quantity of clear water let into the machinery room at the top of the Scrubber, which is discharged at the liquor outlet at the bottom, from Newcastle coal at about 18 to 20 ounces strength, from Yorkshire and other coals generally from 25 to 30 ounces strength; while acidulated litmus or turmeric exposed at the Scrubber outlet will not show the slightest discoloration, and there is not a quarter of a grain of ammonia per 100 feet left unabsorbed.

Applications relating to dimensions and prices should be addressed to us, C. AND W. WALKER, 8, FINSBURY CIRCUS, LONDON, E.C., or to Mr. WILLIAM MANN, late Superintendent of the Chartered Gas-Works, BLACKFRIARS, LONDON; they should state approximately the largest make of gas in 24 hours on a winter's day, and the smallest make on a summer's day, to be purified.

WOLSTON'S TORBAY IRON PAINTS.

THE Torbay and Dart Paint Company, Limited, 23, Great George Street, Westminster, S.W., having been informed that PAINTS not manufactured by them are being offered to Gas Companies and the public as "WOLSTON'S," hereby give notice that they will TAKE PROCEEDINGS against any persons infringing their rights as sole proprietors and manufacturers of Wolston's Torbay Iron Paints.

(See Advertisement on another page.

INTERNATIONAL EXHIBITION, 1862.
CLASS X.
PRIZE MEDAL
For excellence of Fire-Clay Gas Retorts, and
"HONOURABLE MENTION" for
good quality of Fire-Bricks.

WILLIAM STEPHENSON & SONS,
THROCKLEY,
NEWCASTLE-ON-TYNE.

JAMES MILNE & SON,
GAS ENGINEERS,
Gas-Meter, Gas Apparatus, and Gas-Fittings Manufacturers,
EDINBURGH, AND
2, KING EDWARD STREET,
NEWGATE STREET, LONDON.
Meter Works in London—2, CROSS STREET, WILDERNESS ROW, E.C.

STATION-METERS, GOVERNORS, CONSUMERS METERS, GAS LUSTRES, CHANDELIERS, BRACKETS, &c.,
And every description of Gas-Fittings and Gas Apparatus.

THE IMPERIAL METER COMPANY,

KING'S ROAD, LONDON, N.W.,

OFFICE: 9, VICTORIA CHAMBERS, WESTMINSTER, S.W.,

MANUFACTURERS OF

"WET" & "DRY" GAS-METERS IN IRON & TIN-PLATE CASES,

STATION-METERS AND GOVERNORS, STREET-LAMP METERS, BOXES, AND REGULATORS FOR THE AVERAGE METER SYSTEM.

TO GAS COMPANIES, ENGINEERS, &c.

These Works are in full operation, and it will be the aim of the New Company not only to keep up the excellent workmanship of their predecessors, but, by the introduction of special machinery, to manufacture **Meters of a higher standard than is usually given, without increasing the cost.**

Special attention is invited to the Compensating Wet Gas-Meter of De Castro and Burton, which is now becoming so generally adopted, and is more simple in construction than any other Compensating or Ordinary Wet Meter. There is but one centre of friction to be overcome by the gas. By its self-adjusting principle it maintains an unvarying water-line; and the reservoir contains sufficient water to supply the Meter for twelve months without attention. It is unaffected by "tilting," and cannot be "flooded" by any pressure.

The Company also manufacture Dry Meters upon the most improved principle, and all their Meters being made to standard gauges, the most accurate measurement is obtained.

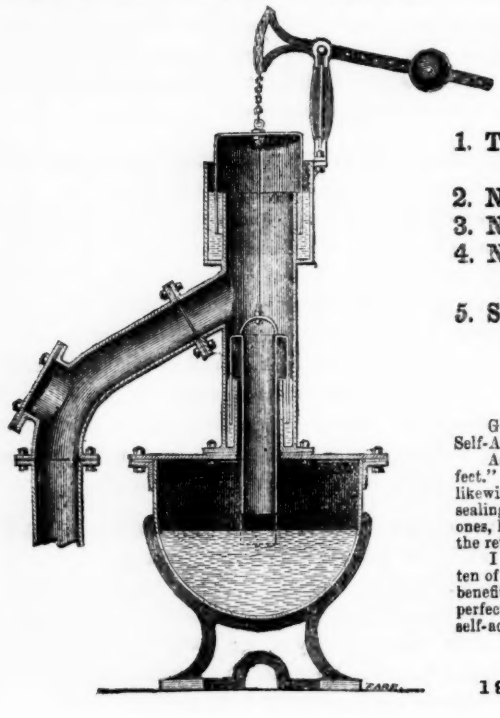
Attention is also called to their Dry Meters in Wood Cases, as used by some of the London Gas Companies. These Cases are a great preservation to Tin-plate Meters, especially in seaport towns, where the air is impregnated with salt; they are also particularly suited for export.

The Company repair or convert every description of Wet Gas-Meters to De Castro and Burton's Patent.

SELF-ACTING REMOVABLE DIP-PIPE,

PATENTED BY

CHANDLER & STEVENSON.



ADVANTAGES.

1. There is no pressure on the Retorts.
2. No deposit of Carbon.
3. No scurfing is required.
4. Never a choked Ascension-Pipe.
5. Saves Fuel and Wear and Tear.
6. Gets 10 per cent. more Gas out of the Coal, and a higher Illuminating Power.
7. Is never out of order.
8. Requires no attention.
9. Is perfectly automatic in its action.

TESTIMONIAL.

Metropolitan District Asylum, Caterham, Surrey, Dec. 14, 1874.

MESSRS. CHANDLER AND STEVENSON.

GENTLEMEN,—I have much pleasure in bearing testimony to the complete working of your "Patent Self-Acting Dip-Pipes," which have now been in constant operation over three months.

As regards the action of the apparatus, I can describe it no better than by calling it "simply perfect." Immediately the retort is charged and the lid secured, the small holder rises, which lifts the Dip; likewise the instant the gas is permitted to escape at the mouthpiece the holder falls, thus perfectly sealing the Dip. I am fully convinced of the superiority of these Self-Acting Dips over Non Self-Acting ones, having experienced the fact that stokers do occasionally neglect to unseal the Dip after charging the retort, thereby causing a waste or loss.

I feel that it is quite unnecessary for me to say more on the subject, excepting that, having had ten of Messrs. Chandler's Dip-Pipes in use more than one year, and having experienced the great benefits derived thereby, inasmuch as the yield of gas from the coal is greatly increased, and the retorts perfectly free from carbon and other advantages, and seeing that the same Dip has been made perfectly self-acting by the second patent, I feel convinced that this is the right thing.—Yours obediently,

W. CRICKMAY, Resident Engineer.

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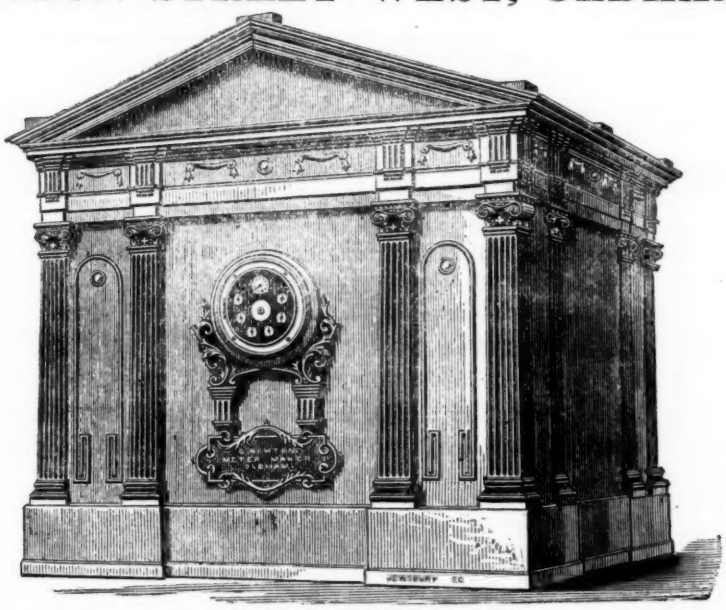

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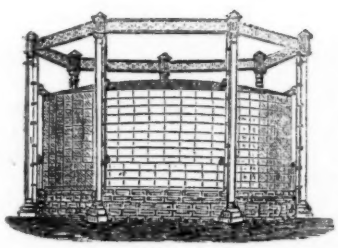

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We submit the above Burners to Managers of Gas Companies as being worth a recommendation to their consumers. Though the price is little more than that of common Burners, we believe them to be nearer perfection, for general use, than any others, however costly.

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PRICES and TESTIMONIALS on APPLICATION.
(See Notice on another page.)

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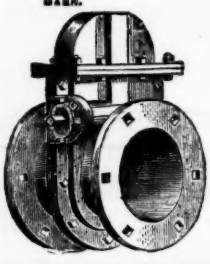

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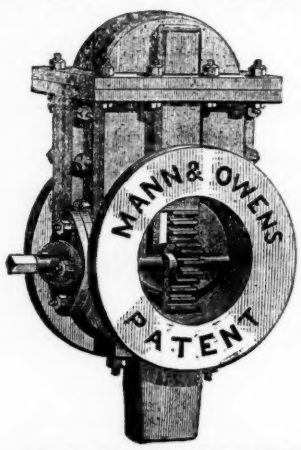

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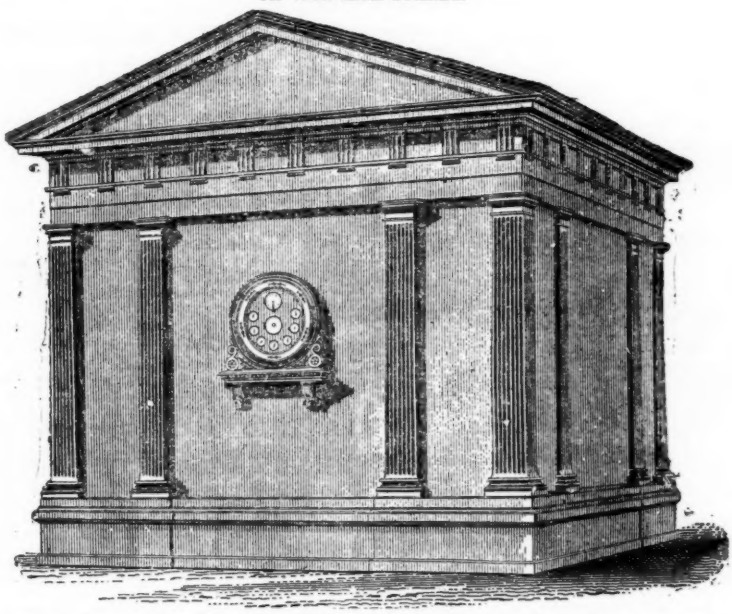

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Cubic Feet.	Illuminating Power.	Coke (sup. qual.).
10,000 ..	20 candles. ..	12 cwt.

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This Cannel produces in actual working, in iron retorts, 9200 cubic feet of 32-candle gas, and upwards of 11 cwt. of coke, and in clay retorts will produce 11,500 cubic feet of 25·9-candle gas.

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CELEBRATED SILKSTONE GAS NUTS.

Analysis by F. J. EVANS, Esq., Chartered Gas Company, Horseferry Road, Westminster:—

(COPY.)

	Cubic Feet of Gas per Ton of Coal.	Illuminating Power in Candles.	Coke per Ton of Coal used.	Ash in Coke, per Cent.	Sulphur in Coal, per Cent.
Silkstone Nuts . . .	10·800	15·85	12·66 cwt.....	6·0	0·69

NOTE.—The illuminating power of the gas was tested by the standard burner now used in London by the Gas Referees, under the City of London Gas Act, 1868.

Horseferry Road, Westminster, March, 1870. (Signed) F. J. EVANS.

These Nuts are extensively used by various Gas Companies throughout the Kingdom, who bear strong testimony to their value.

APPLICATIONS FOR PRICES, &c., TO BE SENT DIRECT TO THE COLLIERY, AS ABOVE.

GAS PURIFICATION & CHEMICAL Co., LIMITED,

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Of superior quality, delivered at any station in England and Wales.

Purified gas per ton of coal in cubic feet (average)	**10,775**
Weight of coke in lbs. per ton of coal	**1,465**

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This Company request attention to the very superior quality of their Cannel Coals.

1. The following are the practical results given by Dr. Wallace, of Glasgow, of analyses of their Lochore and Capledrae Cannels:—

	Sample worked at Capledrae.		Sample worked at Lochore
Gas per ton of coal, at 60° Fahr. and 30 inches barometric pressure . .	13,095 cubic feet.	..	11,760 cubic feet.
Illuminating power, in standard sperm candles, by union jet consuming 5 cubic feet per hour, at ·5-inch pressure	32·91	..	34·83
Value of 1 cubic foot of gas in grains of sperm	780	..	836
Equivalent of a ton of coal in pounds of sperm candles	1,459	..	1,404
Durability of 1 cubic foot by 5-inch flame	69 minutes.	..	71 minutes.
Gravity of the gas (air = 1000)	596	..	594

Remarks.—This (the sample from Capledrae) is a Cannel Coal of first-class quality, giving 13,000 feet of 33-candle gas. It contains only a minute proportion of sulphur, and the ash is almost quite white. The coke is of rather inferior quality.

Remarks on Sample from Lochore.—This is a Cannel Coal of first-class quality, giving a large yield of very rich gas and a coke of medium quality.

2. The following are the practical results of analyses by Dr. Wallace of the Company's Waverley Cannels:—

	Capledrae Waverley.		Lochore Waverley.
Gas per ton of coal, at 60° Fahr. and 30 inches barometer	9,120 cubic feet.	..	11,145 cubic feet.
Illuminating power, in standard candles, by union jet consuming 5 cubic feet per hour, at ·5-inch pressure	36·62	..	33·09
Value of 1 cubic foot of gas in grains of sperm	878	..	794
Equivalent of a ton of coal in pounds of sperm candles	1,145	..	1,264
Durability of 1 cubic foot of gas by 5-inch flame	80 minutes.	..	67 minutes.
Gravity of the gas (air = 1000)	677	..	597

Remarks on the Sample of Capledrae Waverley.—This Coal gives fully 9000 feet of gas of 36½ candles, and is admirably adapted for bringing up the quality of gas made from common coal or inferior qualities of cannel. The tests were made at a rather high temperature, this being one of the coals that stand a very high heat without serious diminution of the illuminating power of the gas The coke contains 60 per cent. of ash, and is therefore almost valueless, but the proportion of sulphur is very moderate.

Remarks on the Lochore Waverley.—This is a first-class Cannel Coal, giving 11,000 cubic feet of 33-candle gas. The quantity of sulphur is very minute, and the ash is nearly white. The coke is of inferior quality, but not wholly valueless.

Applications for full Copies of Analyses and Prices may be made to the Company, at

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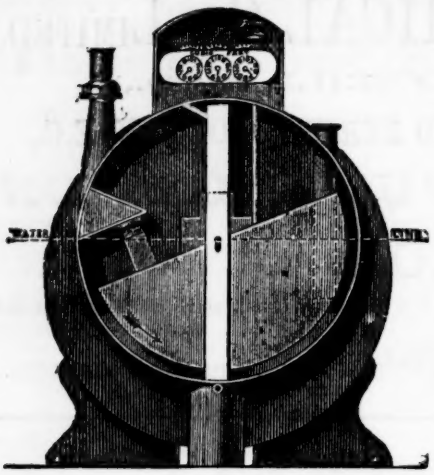

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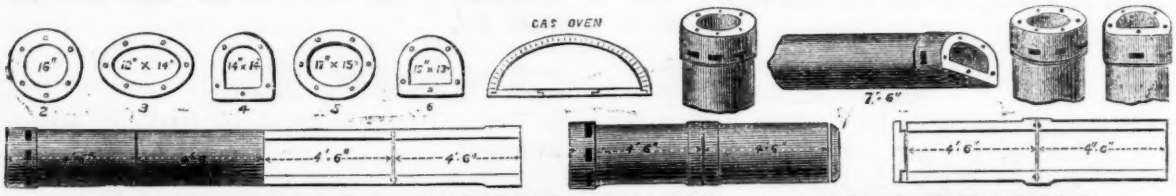

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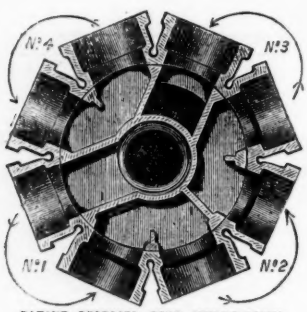

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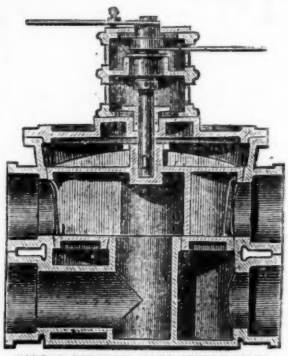

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